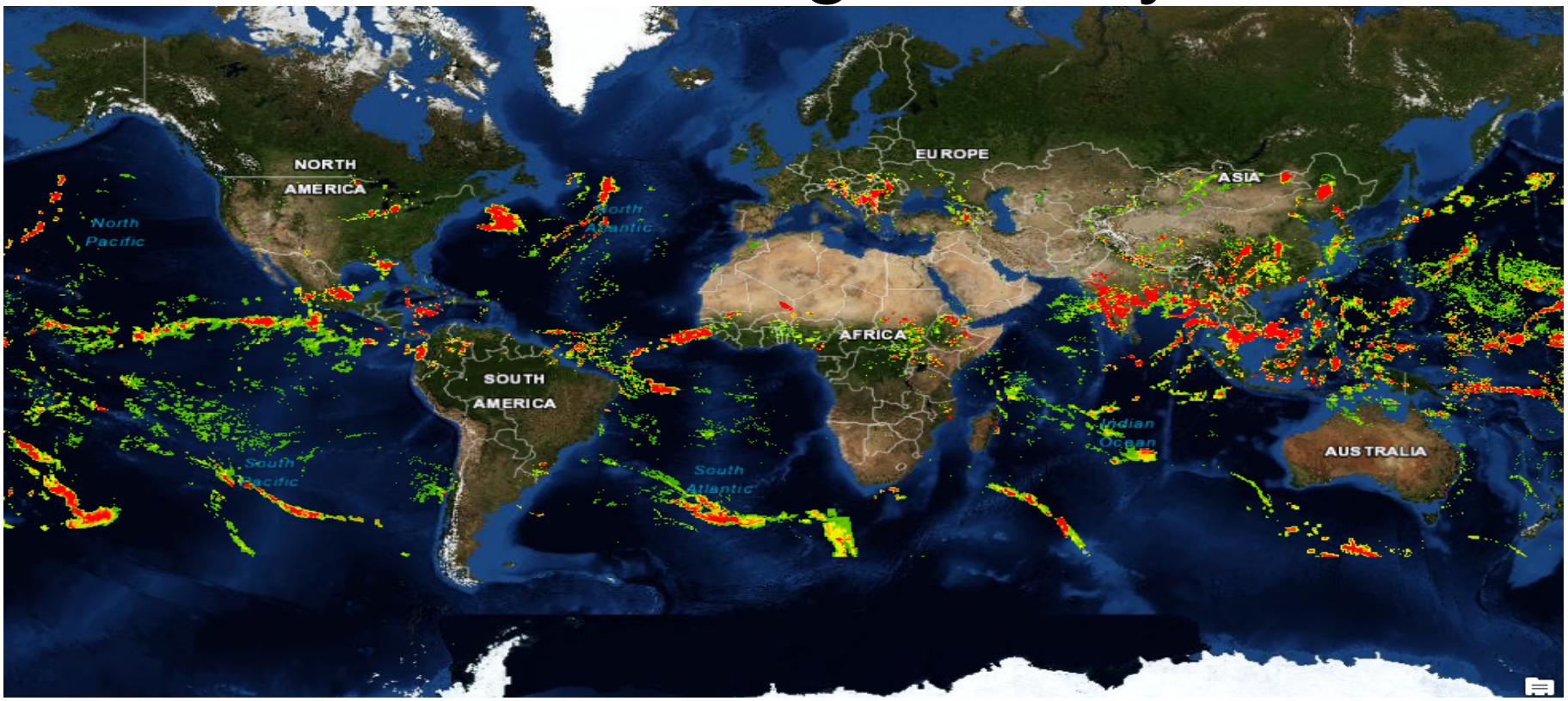
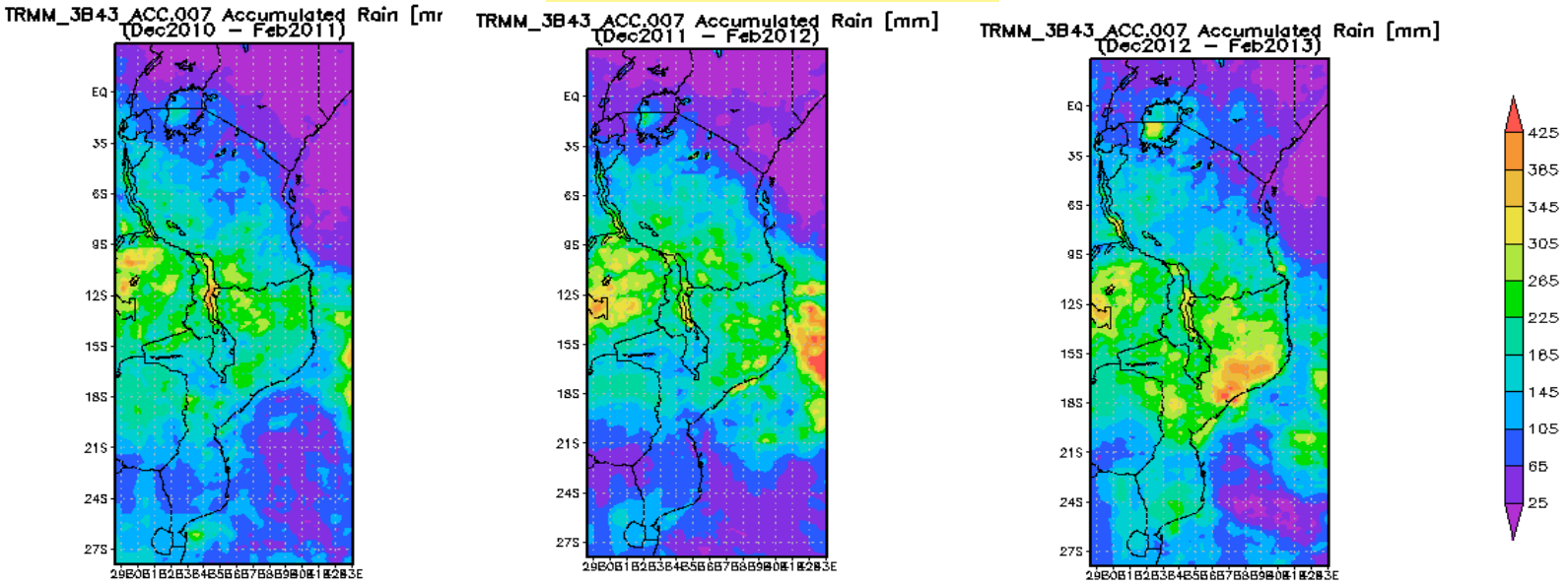
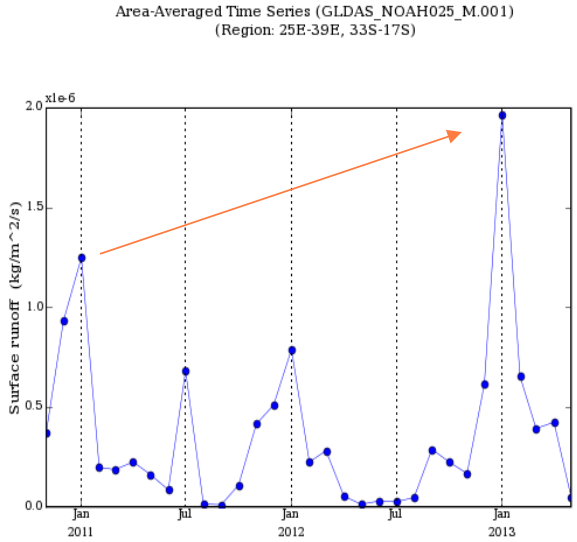
TRMM and GLDAS Monthly Data Acquisition and Importation to ArcMap for Water Budget Analysis



Heavy Precipitation Conditions over Limpopo River Basin (Southern Africa) in 2013

TRMM Accumulated Rainfall





- Seasonal and annual variability in accumulated rainfall data products due to its relavance to heavy rainfall conditions
- Seasonal and annual comparisons:

Dec-Feb (2010-2013)

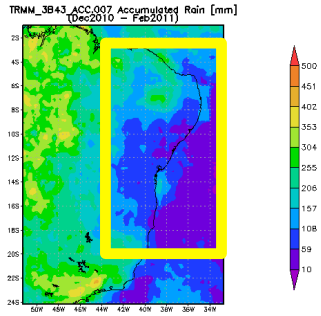
- In relation to surface runoff (kg/m^2/s) obtained from GLDAS
- Freely available NASA data will be imported into GIS where it can be examined together with GIS layers

(hydrologic basins, river networks, elevation, soil type, agricultural lands, dams, reservoirs, population)

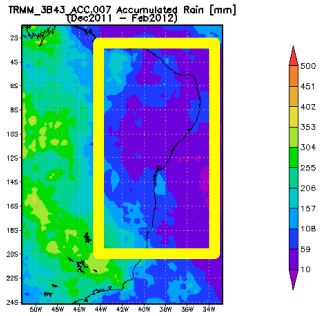
Drought Conditions over Brazil 2012

TRMM Accumulated Rainfall

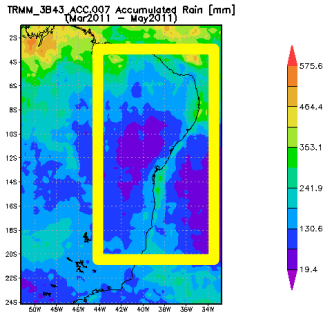
Dec2010-Feb2011



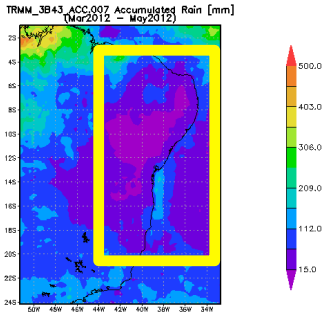
Dec2011-Feb2012



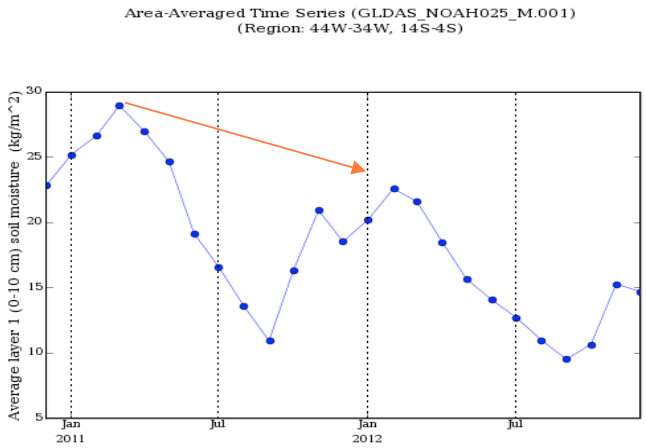
Mar2010-May2011



Mar2011-May2012



GLDAS Soil Moisture



- We will examine seasonal and annual variability in accumulated rainfall data products due to its relavance to drought conditions
- Seasonal and annual comparisons temporal range:
- Dec-Feb (2011-2012) and Mar-May (2011-2012)
- In relation to soil moisture (kg/m^2) obtained from GLDAS

GIS Data Layers

Rivers/Basins	USGS HydroSHEDS	http://hydrosheds.cr.usgs.gov/
Population	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Elevation	Consortium for Spatial Information (CGIAR-CSI)	http://srtm.csi.cgiar.org/
Reservoirs	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Soil Type	ISRIC - World Soil Information	http://www.isric.org/
Dams	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Agricultural Lands	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Land Use	Waterbase	http://www.waterbase.org
Global, National Administrative Areas	Global Administrative Areas	http://www.gadm.org/
Global Base Maps	ESRI Base maps	http://www.esri.com/data/basemaps

Web Tools

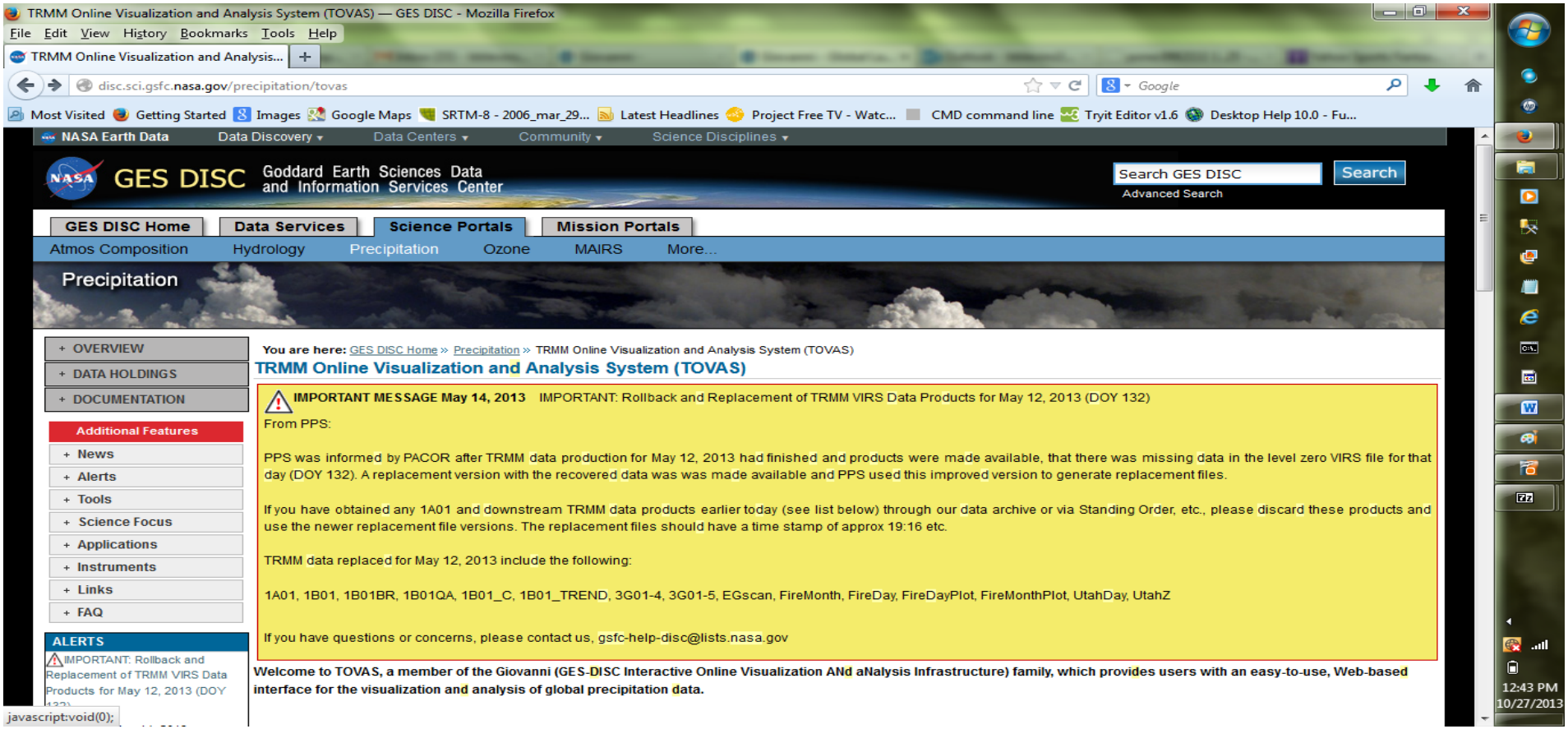
TRMM Online Visualization and Analysis System (TOVAS)

http://disc.sci.gsfc.nasa.gov/precipitation/tovas

Giovanni - Interactive Visualization and Analysis

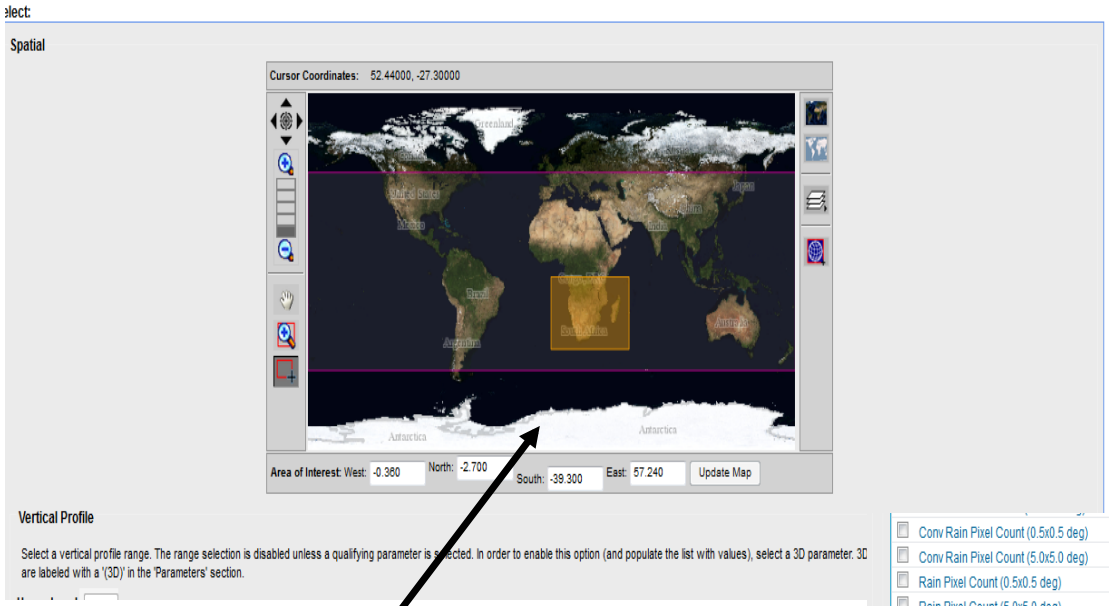
http://disc.sci.gsfc.nasa.gov/giovanni#instances

Go to Giovanni, Science Portals, Precipitation: TRMM – TOVAS



Satellite Rainfall Archives:
Monthly TRMM and Other Data Sources Rainfall Estimate (3B43, 3A12, 3A25 V7)

Giovanni -TRMM 3B43



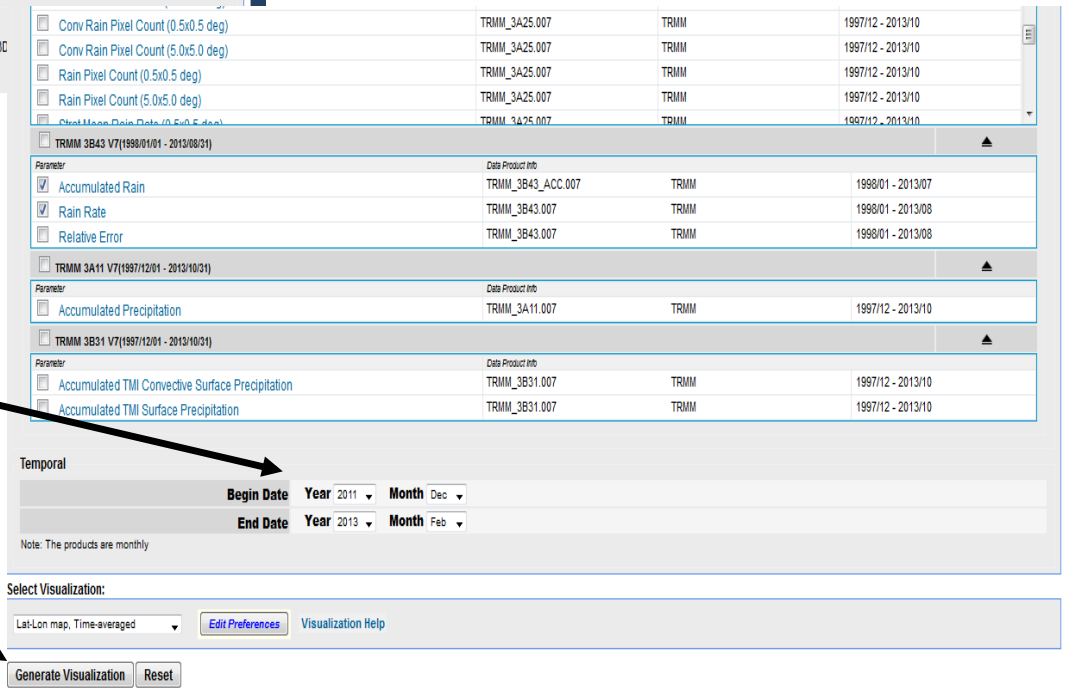
LIMPOPO RIVER BASIN

TRMM 3B43 V7

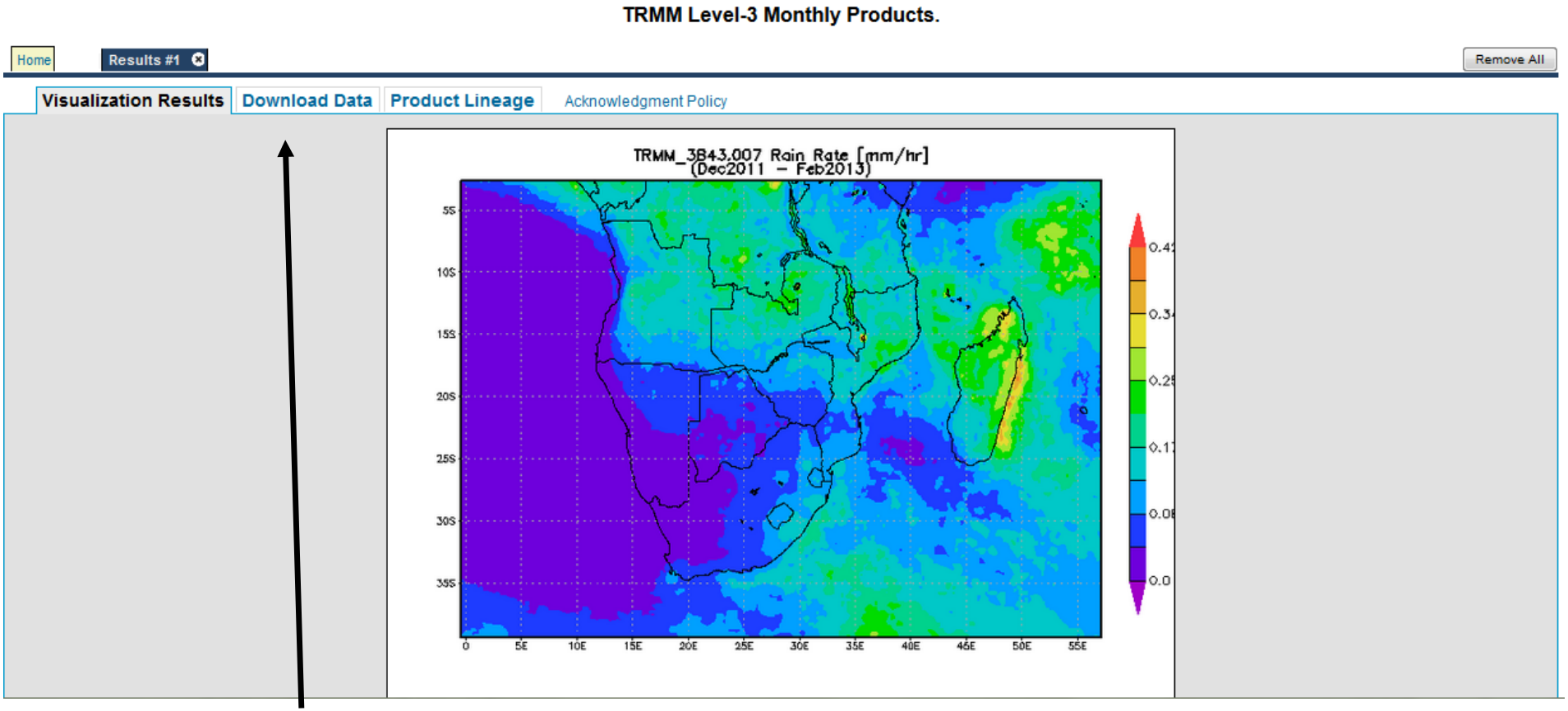
Choose accumulated rain and rain rate

Select region and time frame.

Generate Visualization.as Lat-Lon map, time-averaged.

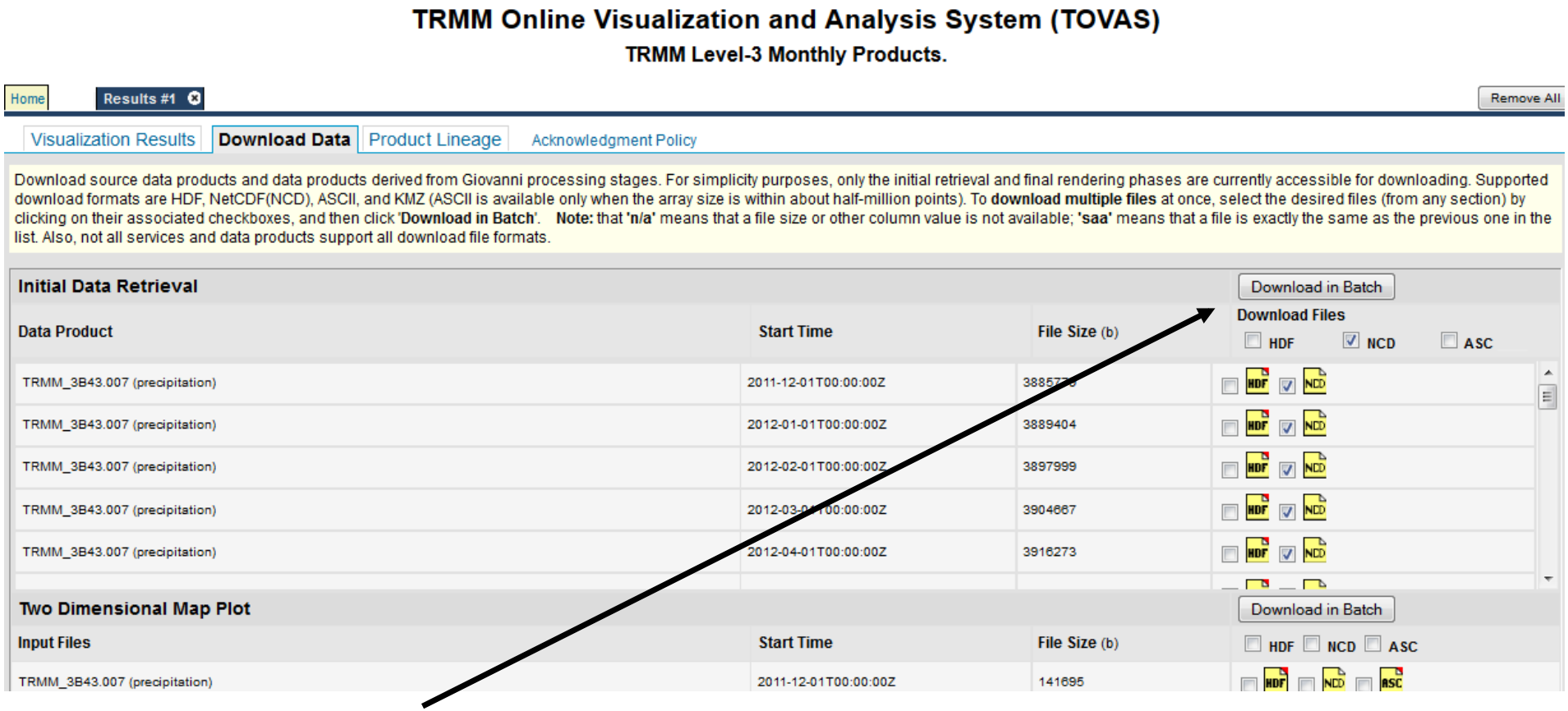


Visualization Results



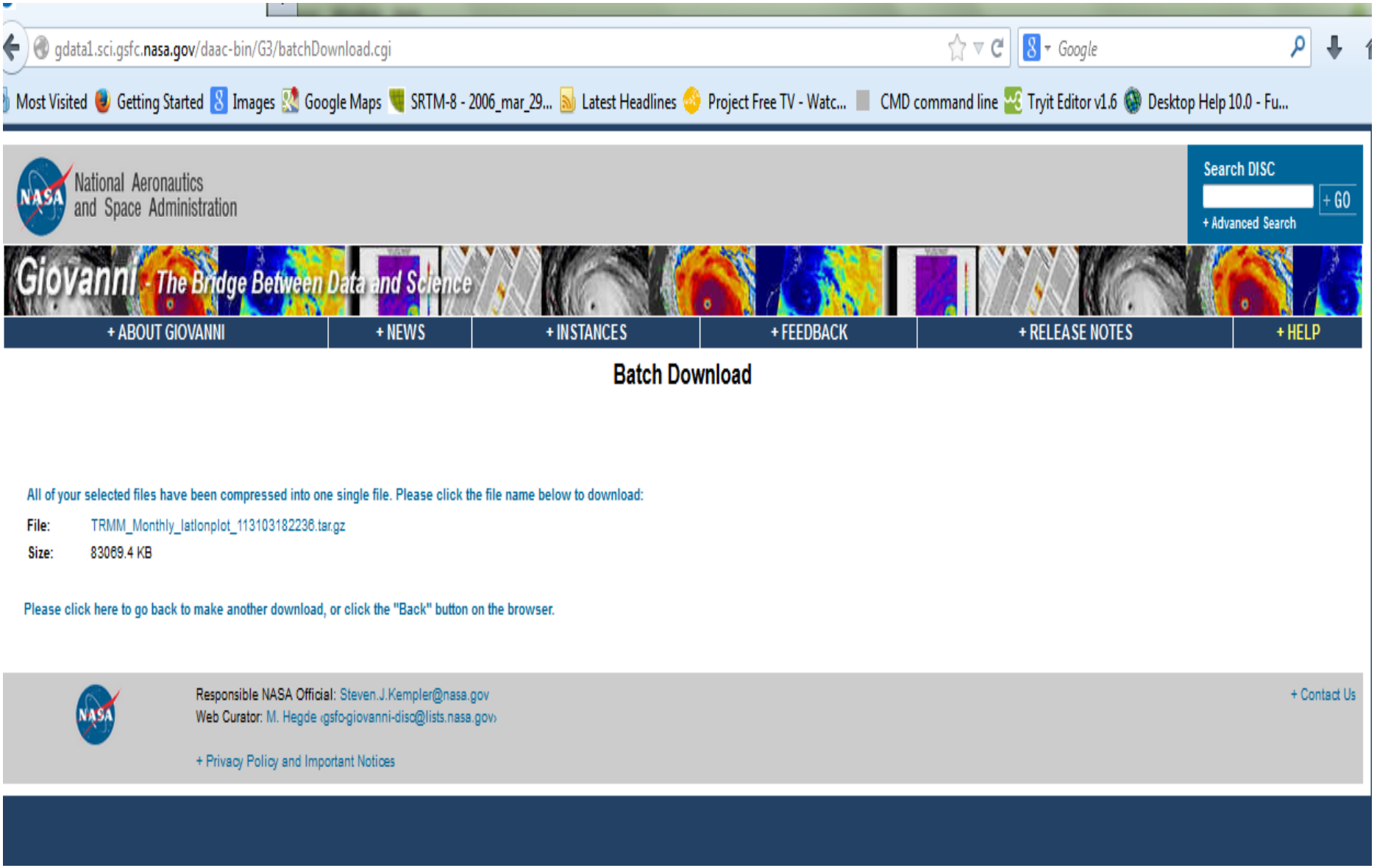
Open the Download Data tab.

Download NetCDF Files



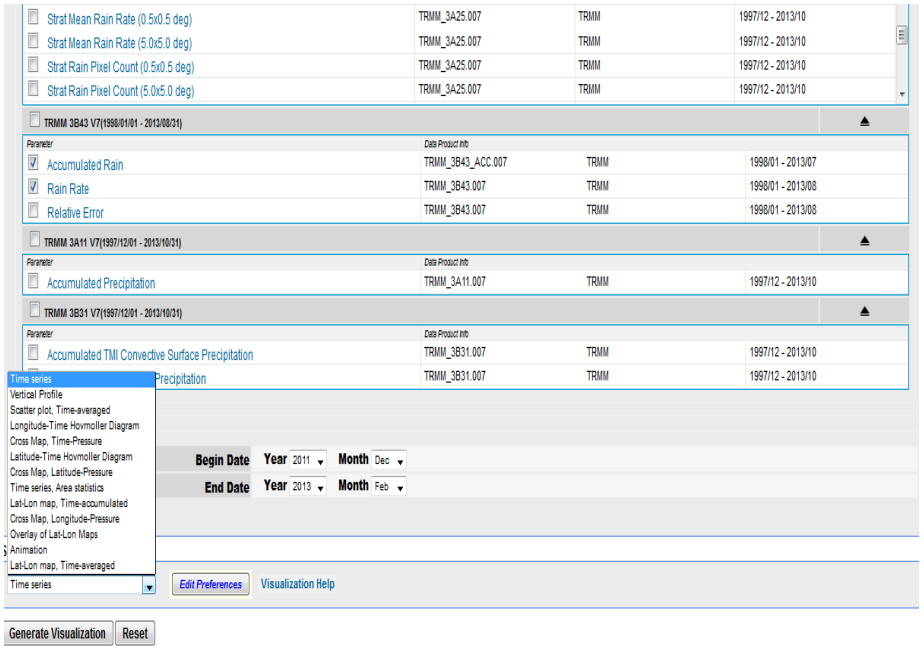
Check the NCD and Download in Batch

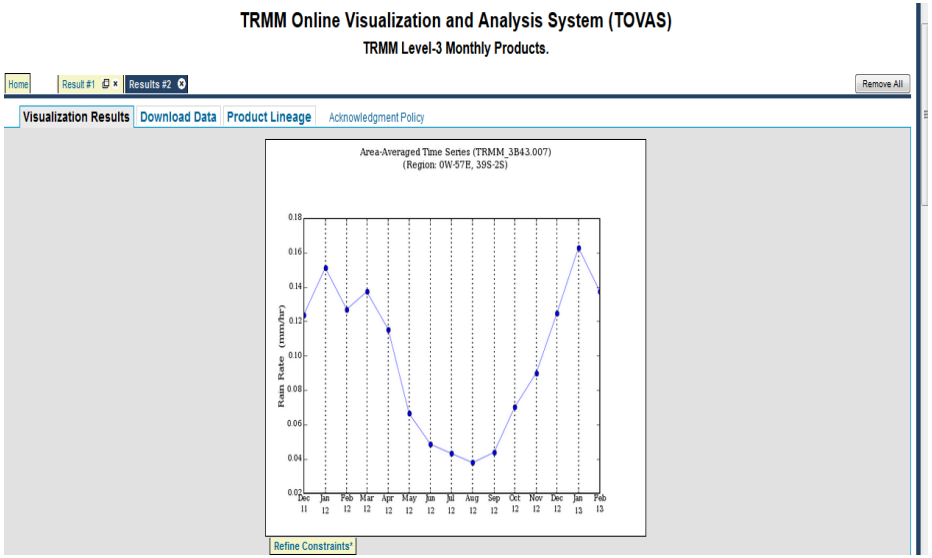
Downloaded zip file. Click link to save file to desired location.



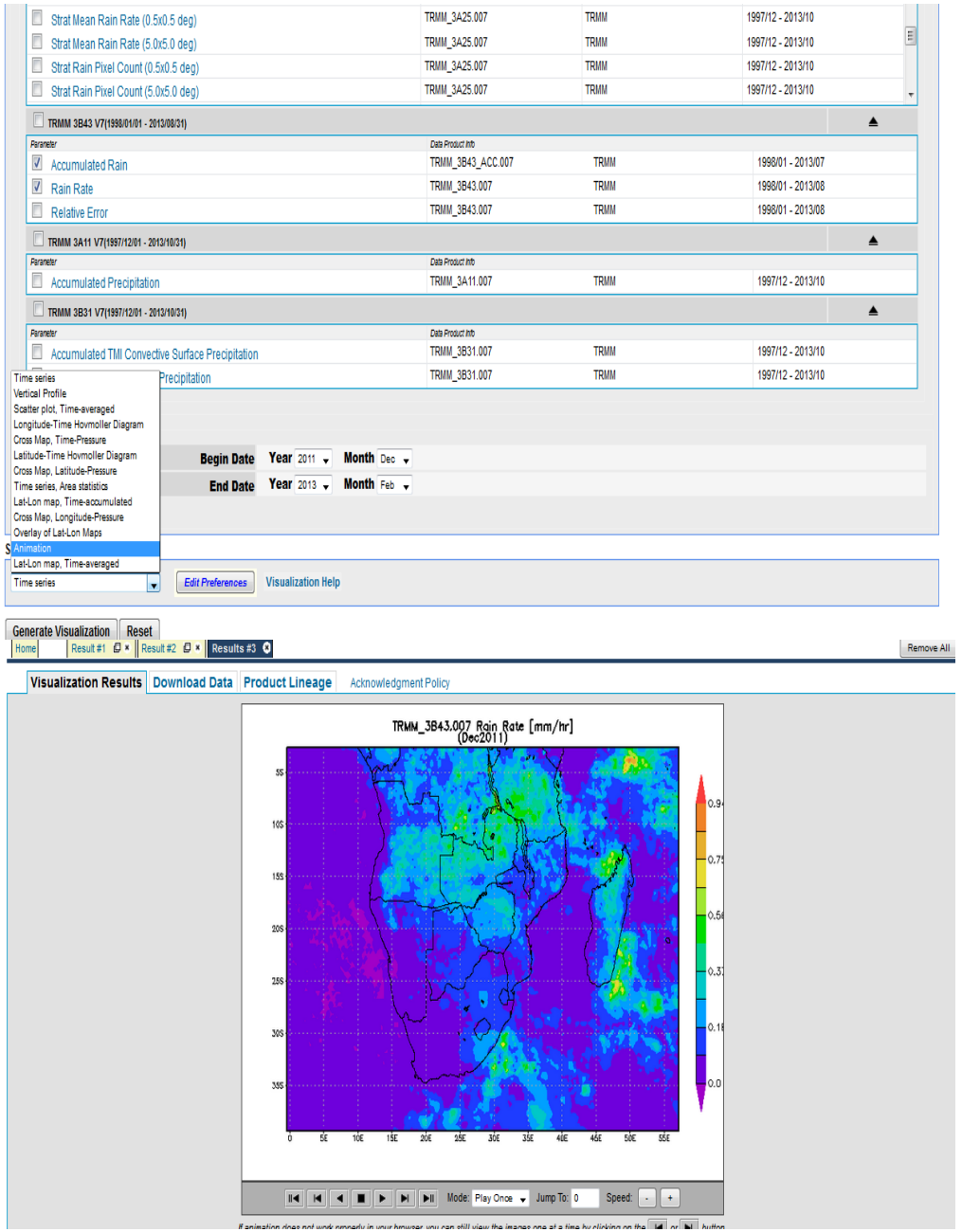
Alternatively, you may go back and choose various visualizations, including

time series plots



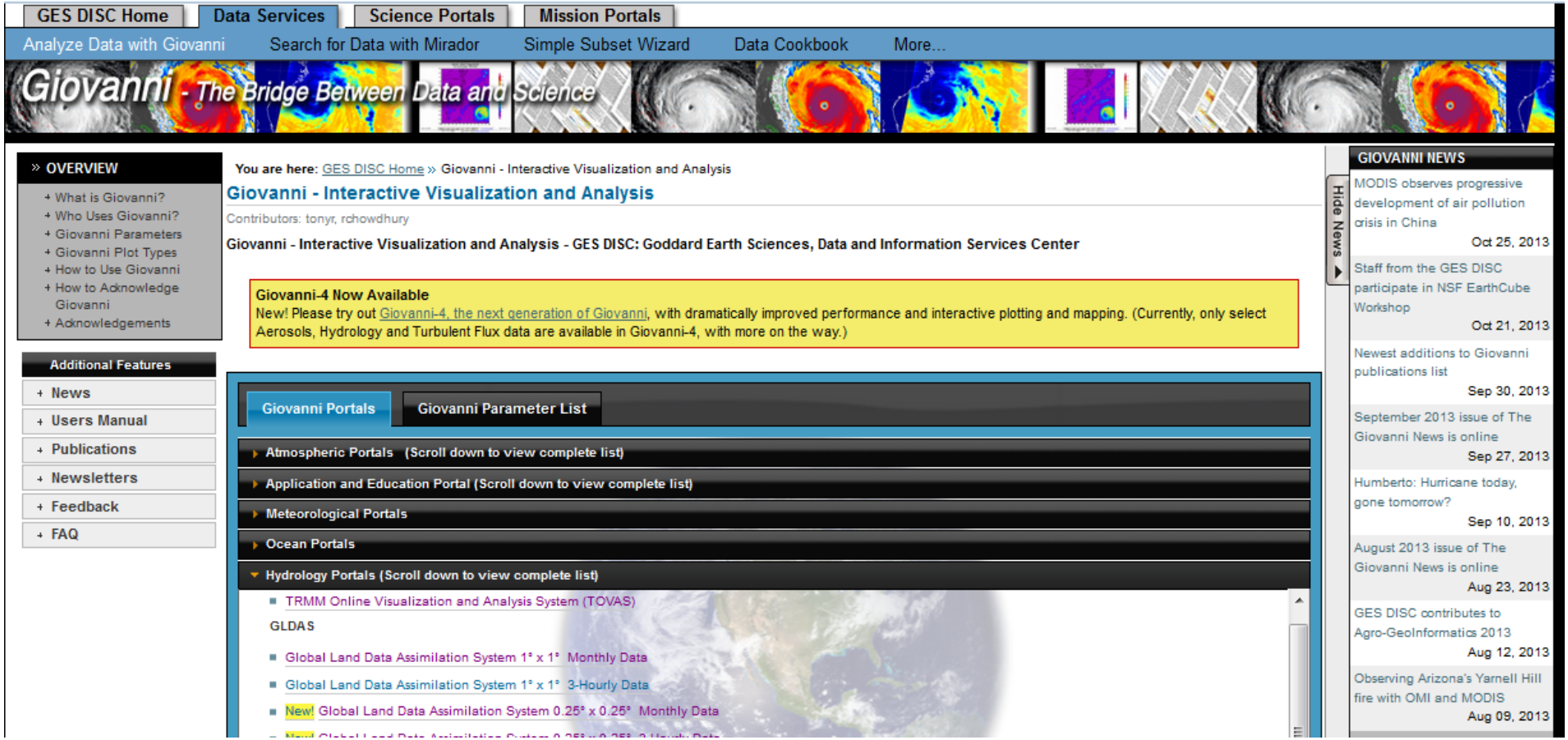


Animation visualization

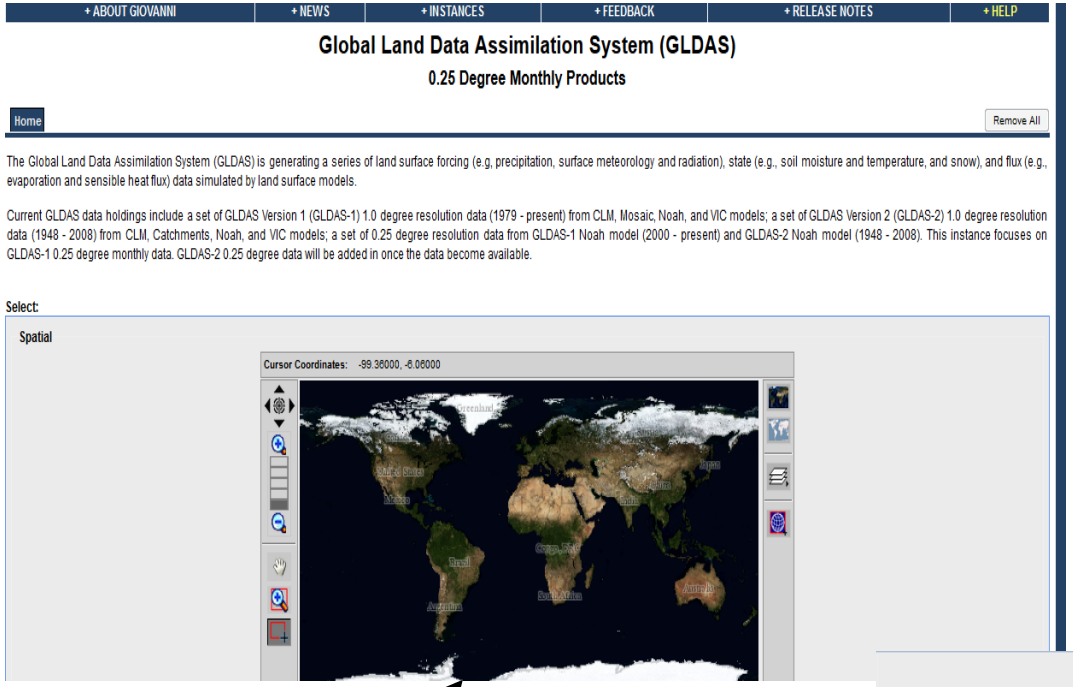


GLDAS products from the four land surface models: Mosaic, Noah, CLM (Community Land Model), and VIC (Variable Infiltration Capacity), can be accessed through Giovanni.

Giovanni:
http://disc.sci.gsfc.nasa.gov/giovanni



Global Land Data Assimilation System 0.25° x 0.25° Monthly Data

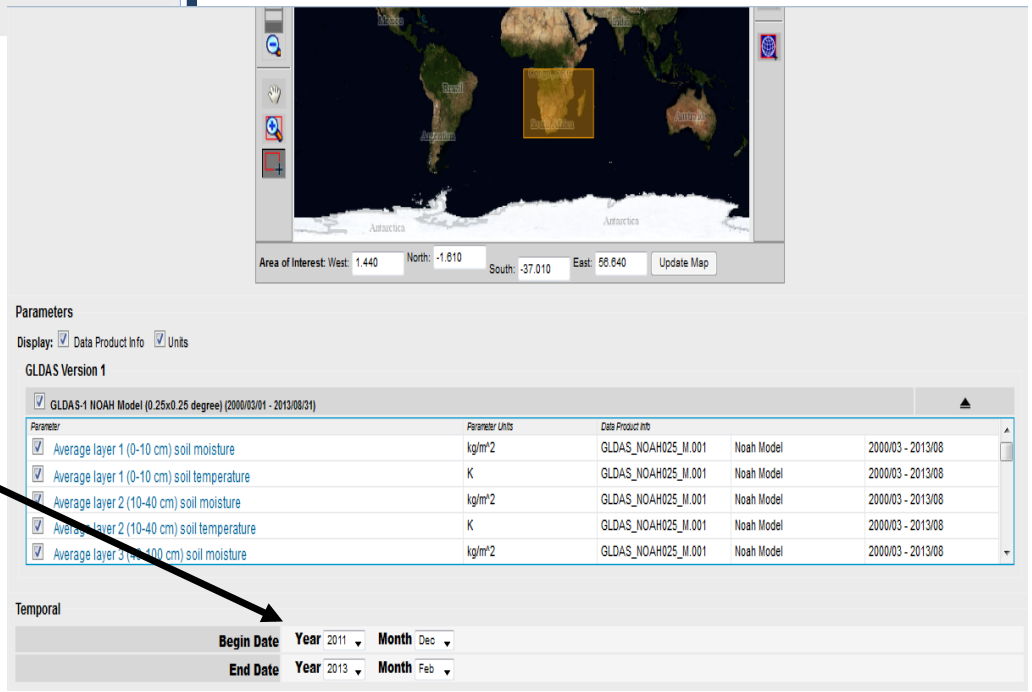


Global Land Data Assimilation System (GLDAS)

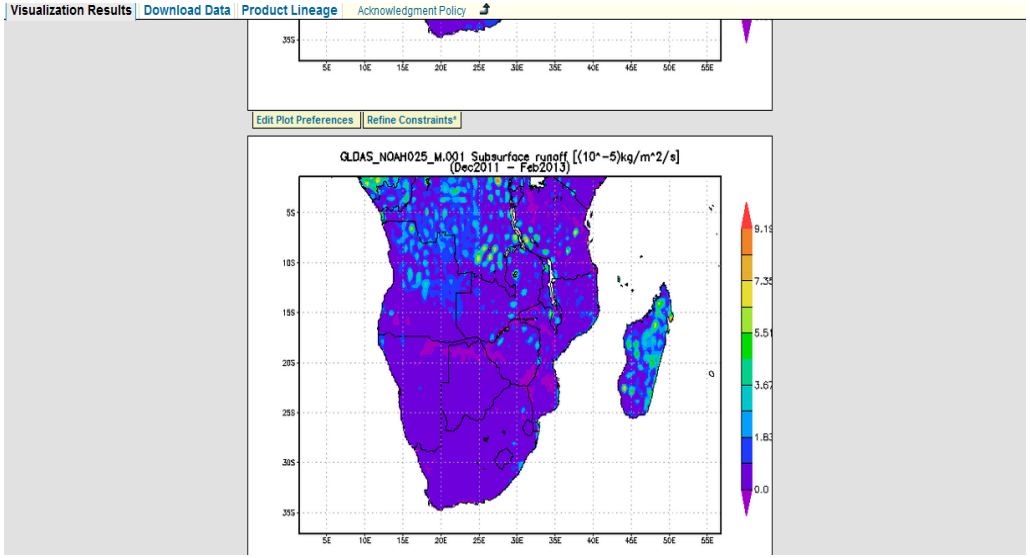
- 0.25 Degree Monthly Products

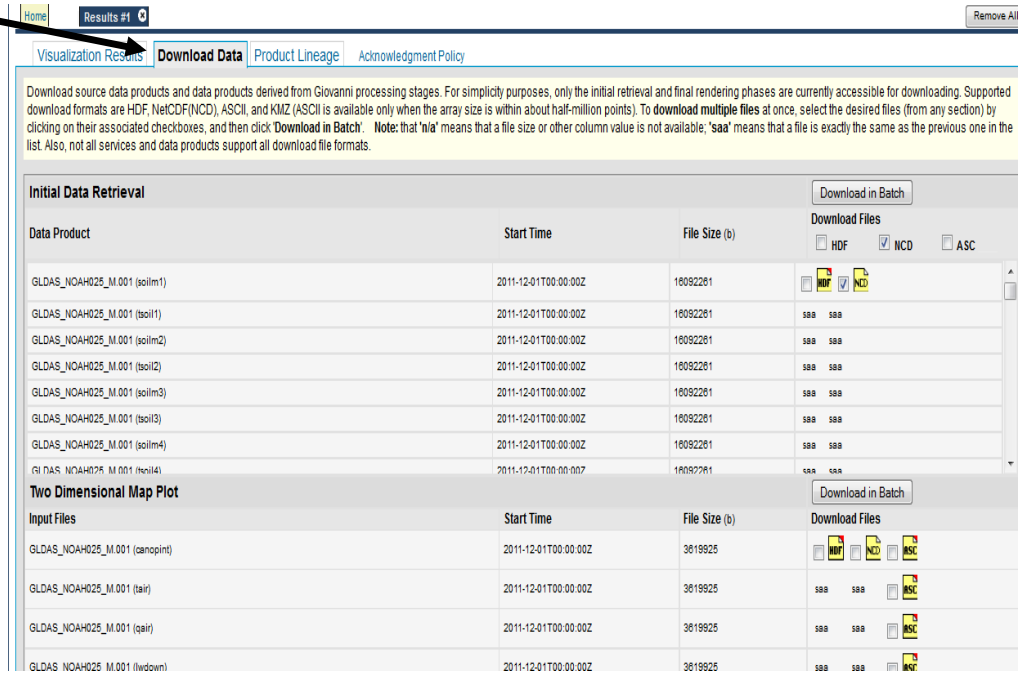
Select region and time frame.

Generate Visualization as Lat-Lon map, time-averaged.

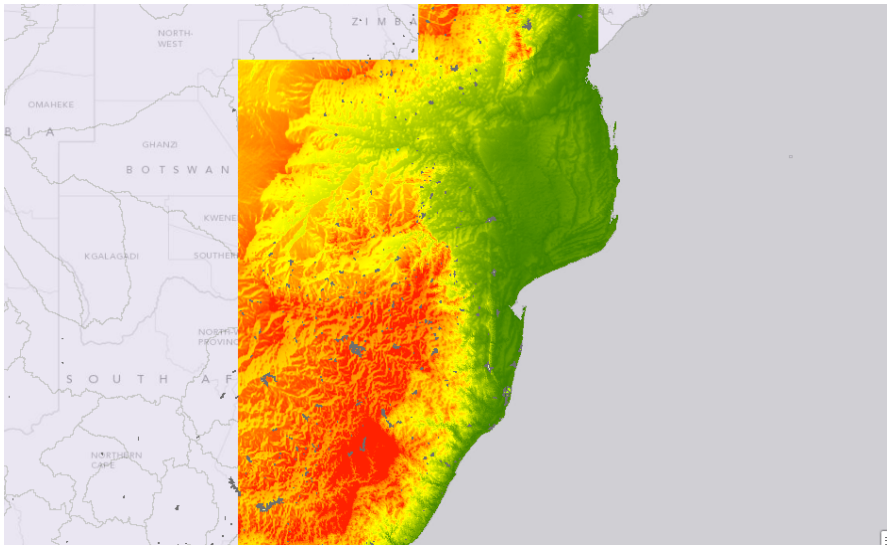


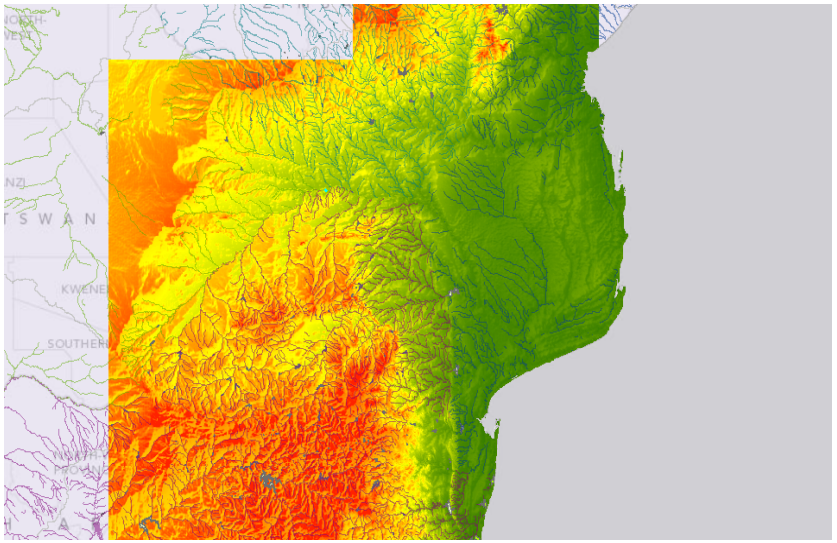
Similar to the TRMM data routine, after the visualization has been generated, download the data. If there are many files, a batch download is available in a zipped file format.

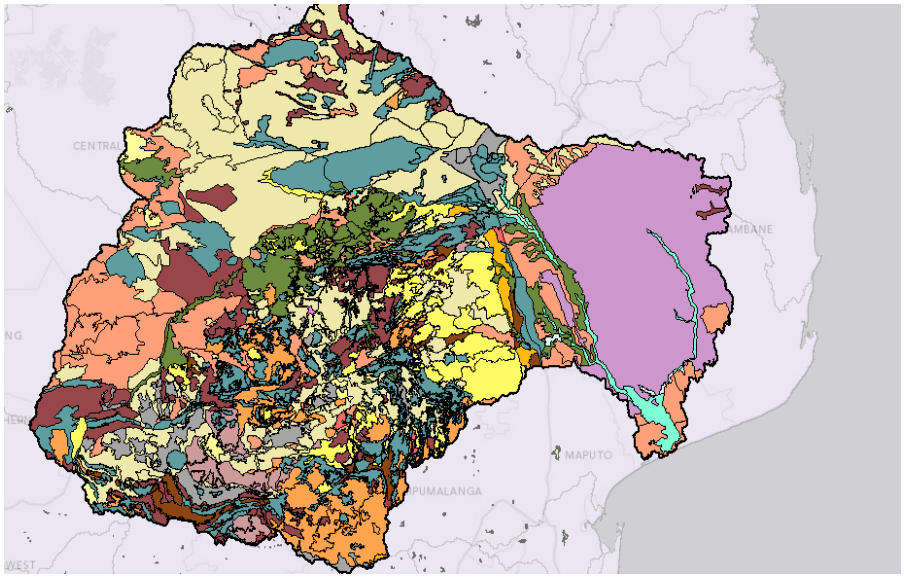




ESRI – ArcMap – Limpopo River Basin







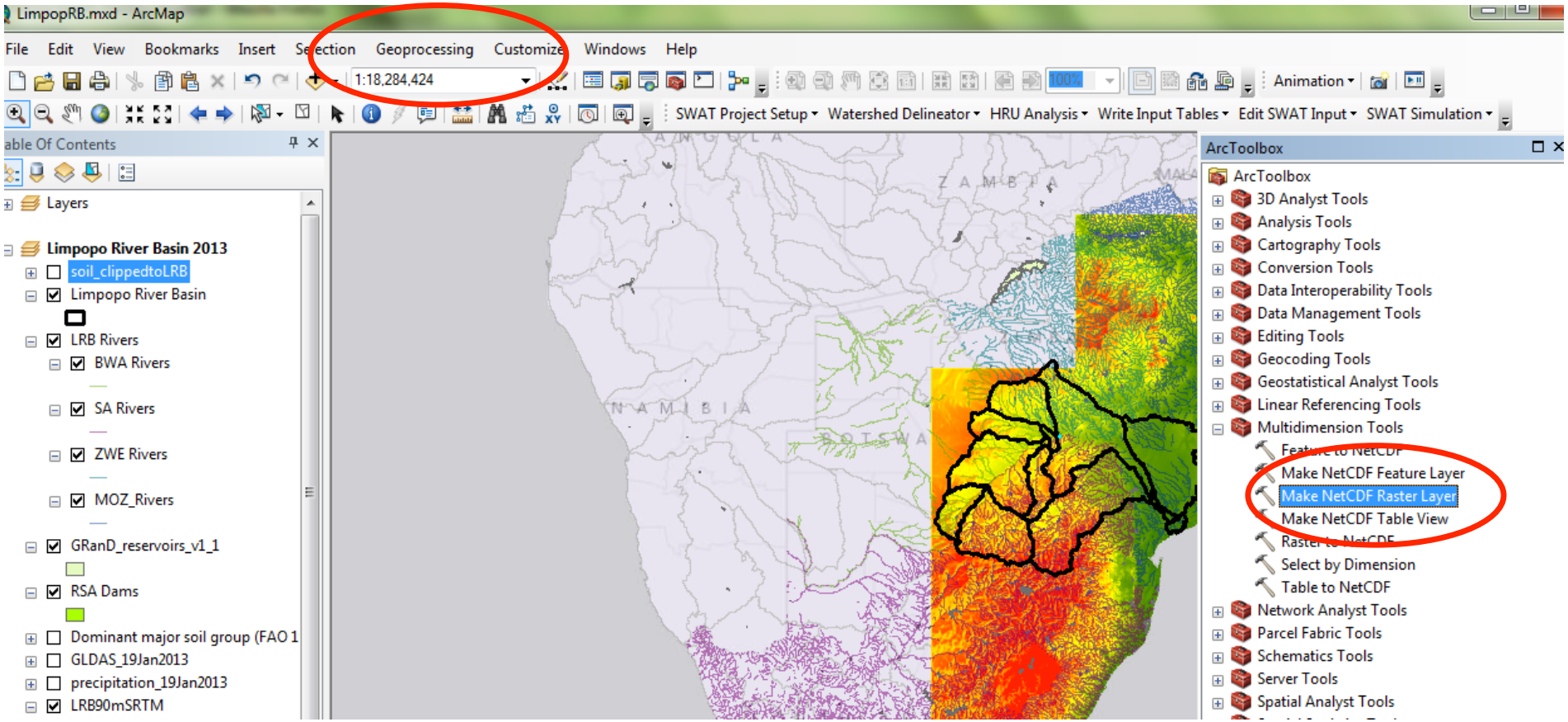
Relavant data layers

- STRM elevation data
- Rivers
- Hydrological Units
- Soil type
- population data
- Land Use/ Land Cover
- Infrastructure

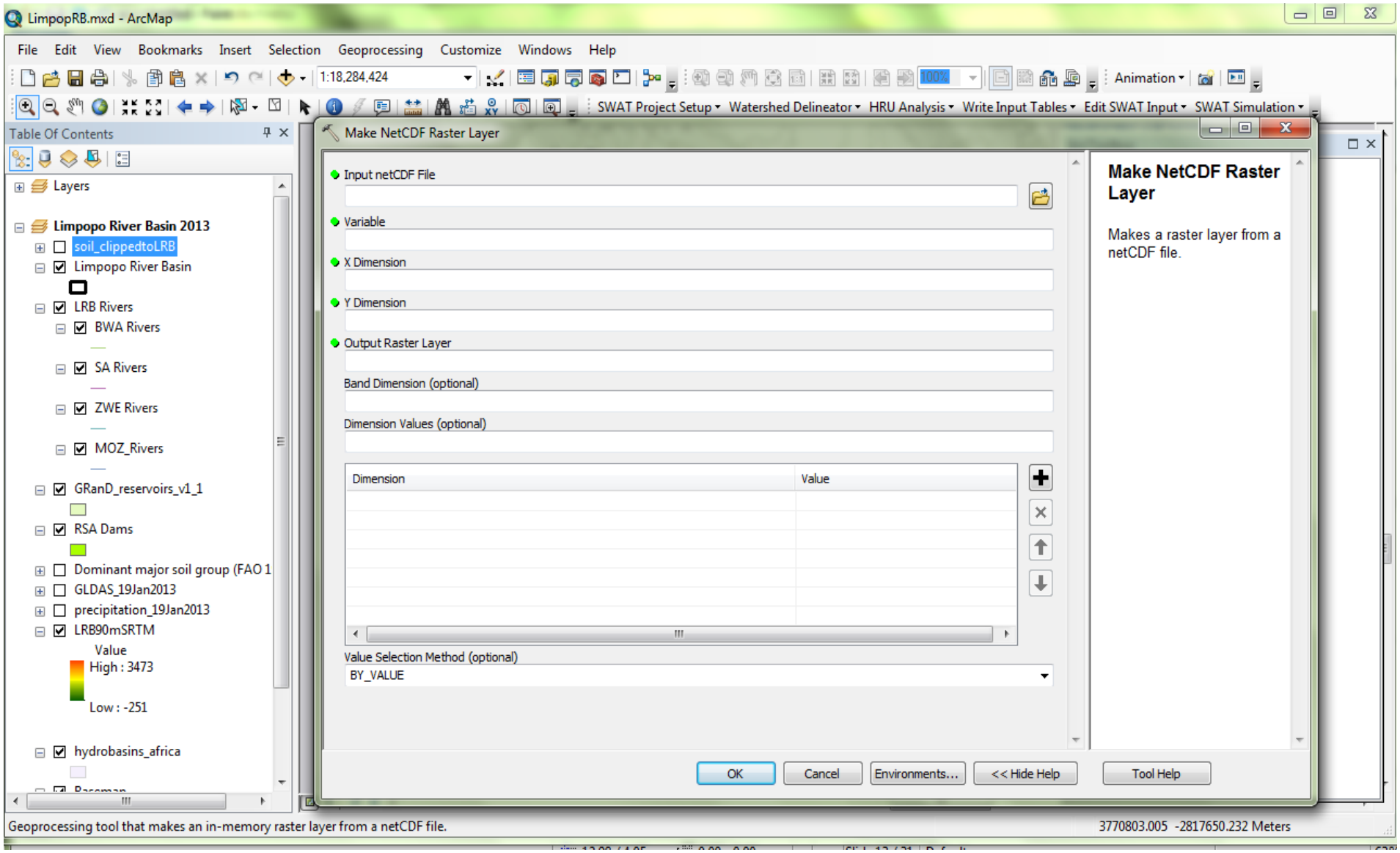
GIS Data Layers

Rivers/Basins	USGS HydroSHEDS	http://hydrosheds.cr.usgs.gov/
Population	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Elevation	Consortium for Spatial Information (CGIAR-CSI)	http://srtm.csi.cgiar.org/
Reservoirs	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Soil Type	ISRIC - World Soil Information	http://www.isric.org/
Dams	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Agricultural Lands	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Land Use	Waterbase	http://www.waterbase.org
Global, National Administrative Areas	Global Administrative Areas	http://www.gadm.org/
Global Base Maps	ESRI Base maps	http://www.esri.com/data/basemaps

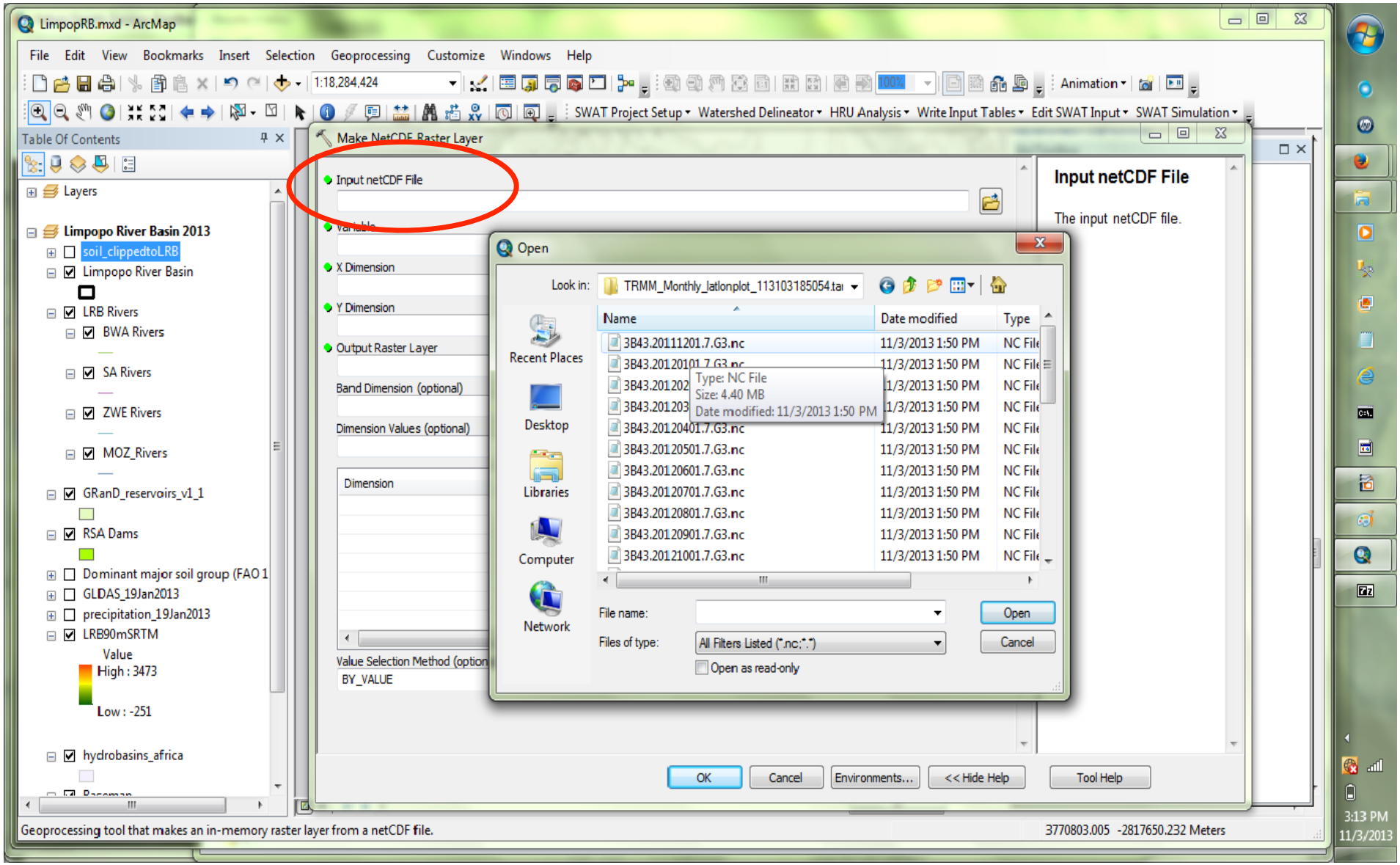
Import TRMM Data



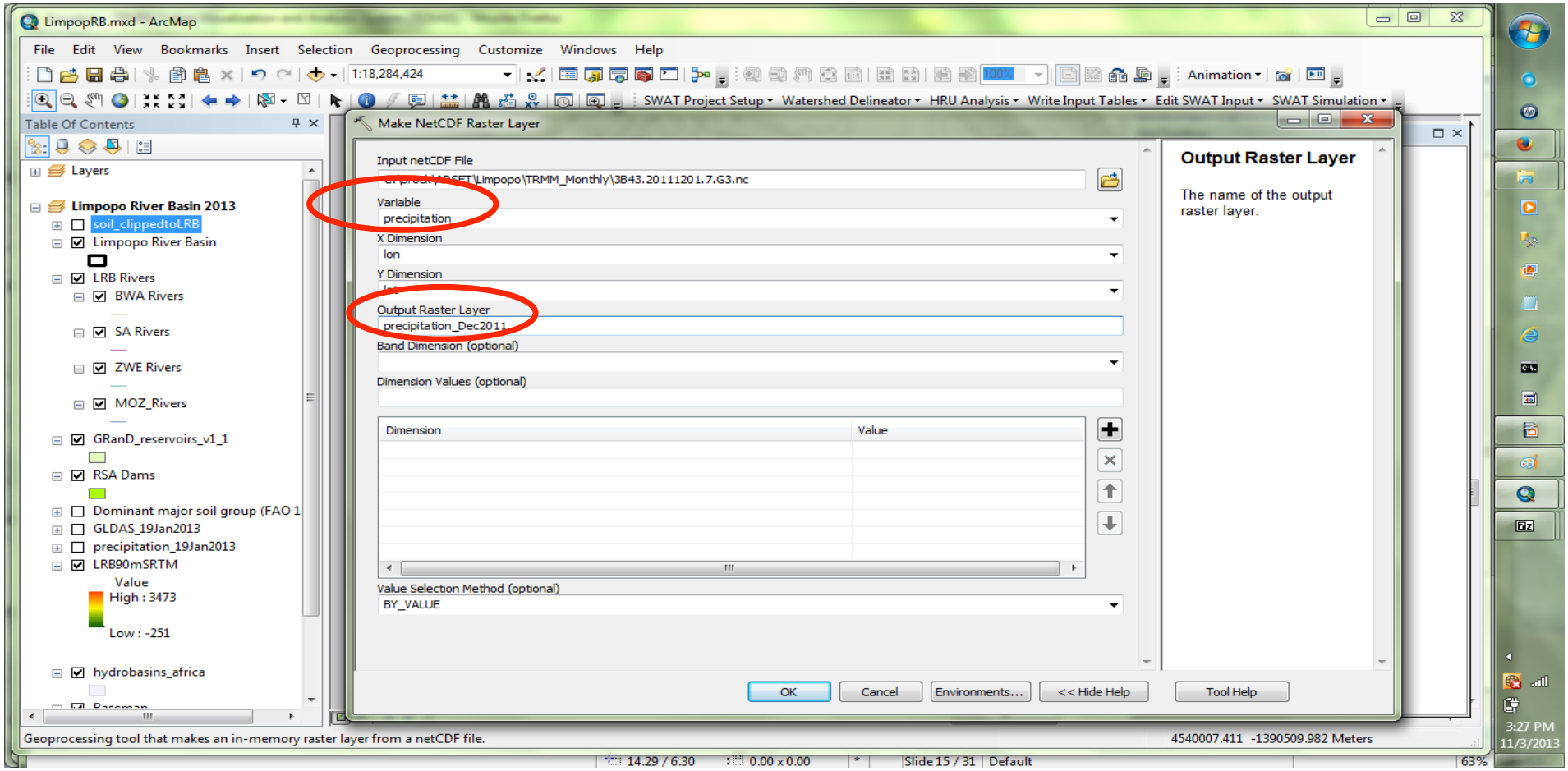
Under the Geoprocessing Tab, Open the ArcToolbox.Open the Multidemensional toolbox, choose the Make NetCDF Raster Layer tool



Make netCDF Raster Layer tool



Select your netCDF file for the Input netCDF File value

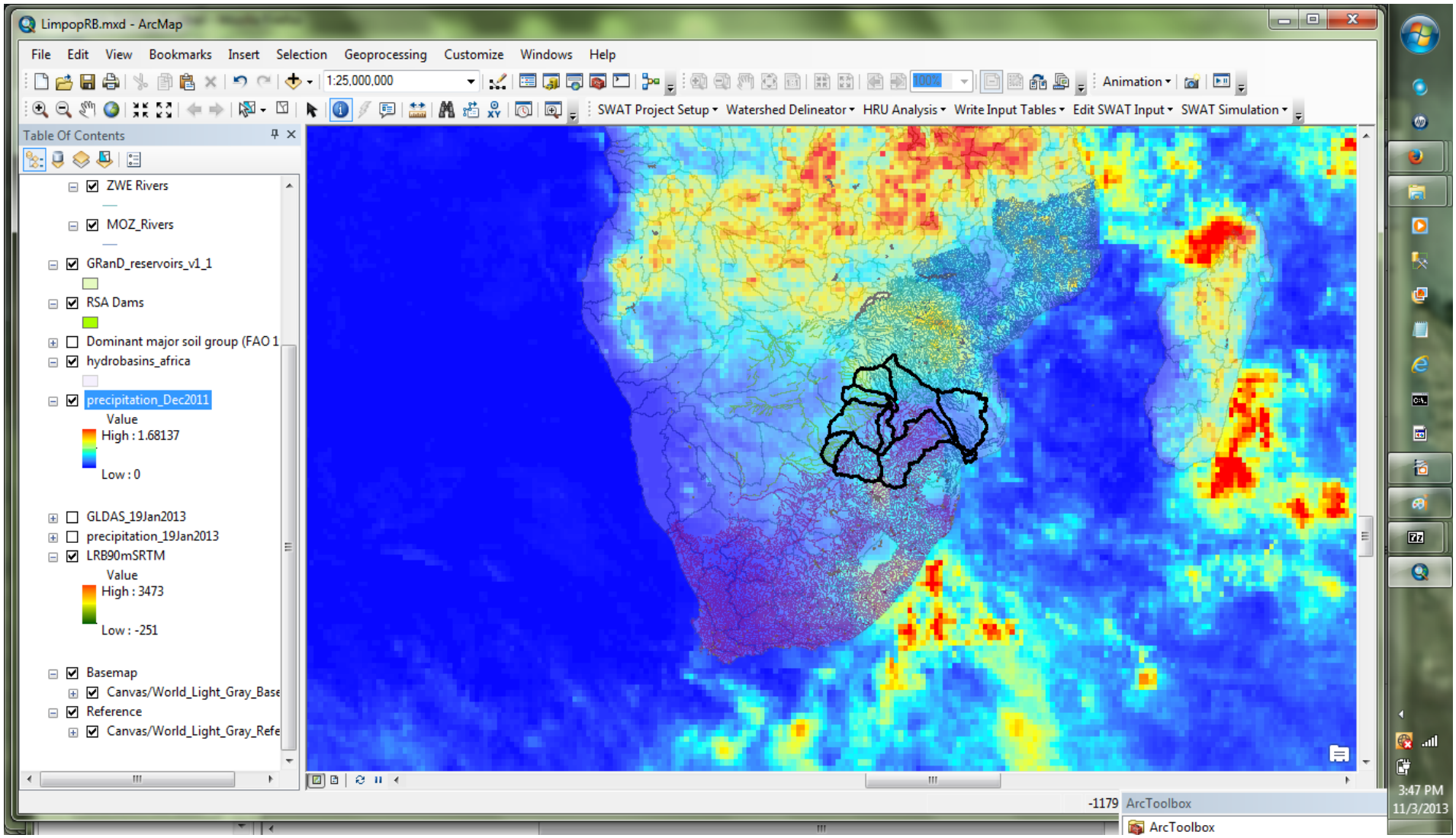


In the Variable field, under the dropdown menu, choose accumulated precipitation.

For the X Dimension field, choose longitude (lon). For the Y Dimension field, choose longitude (lat). These are the defaults settings.

For the Output Raster Layer, type an appropriate name for the resulting raster file to be created. The date, time and variable being displayed is suggested.

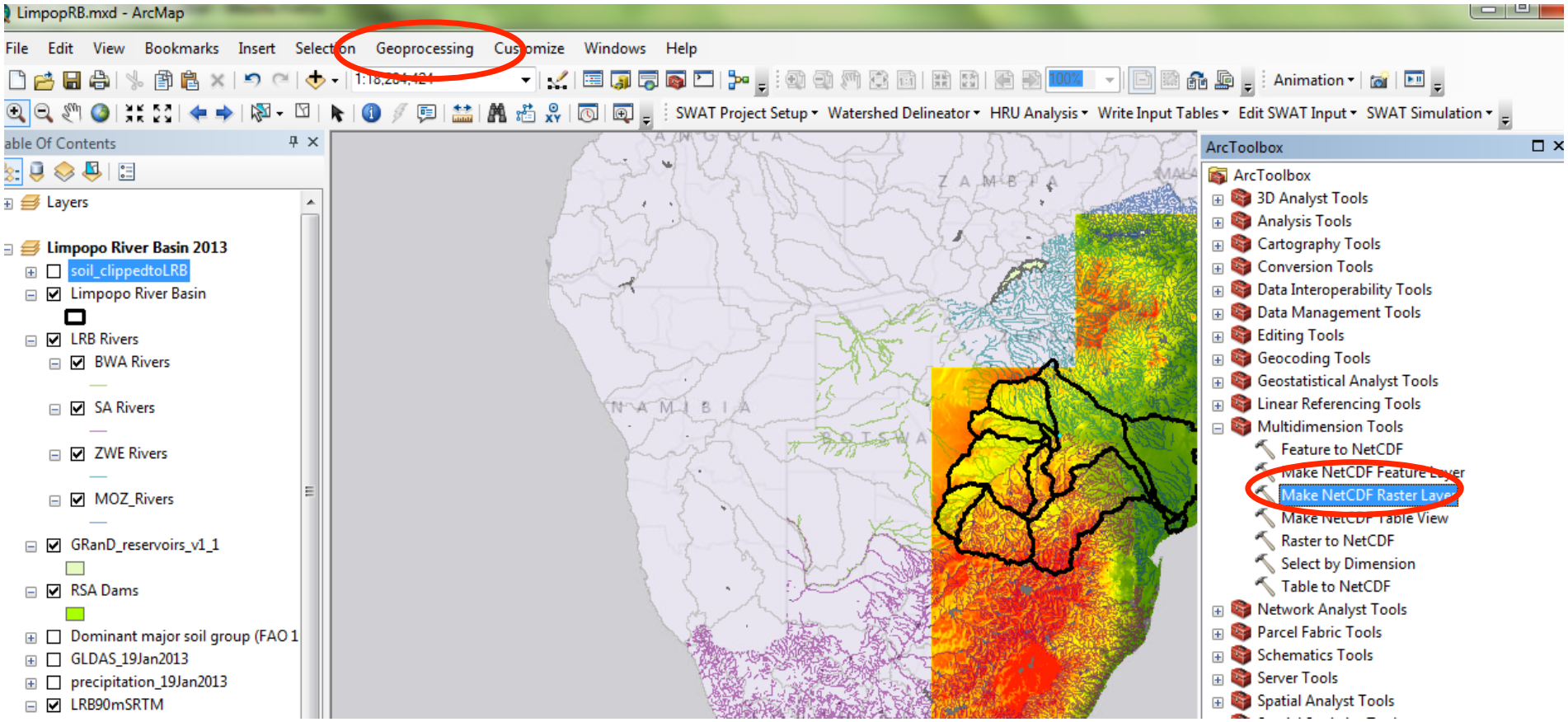
Click ok.



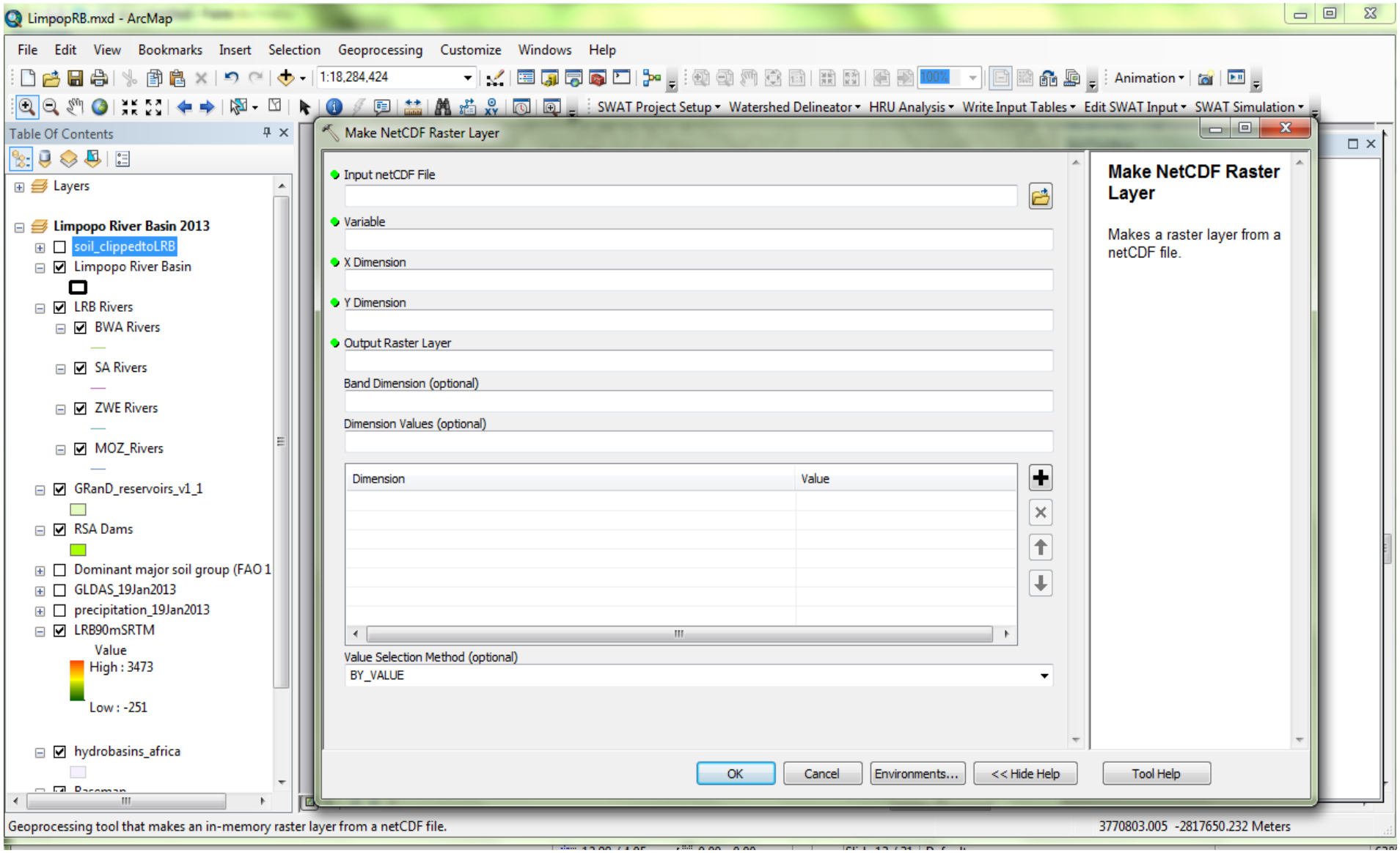
Importation Results

Repeat this routine all monthly TRMM precipitation and Accumulated precipitation netCDF files.

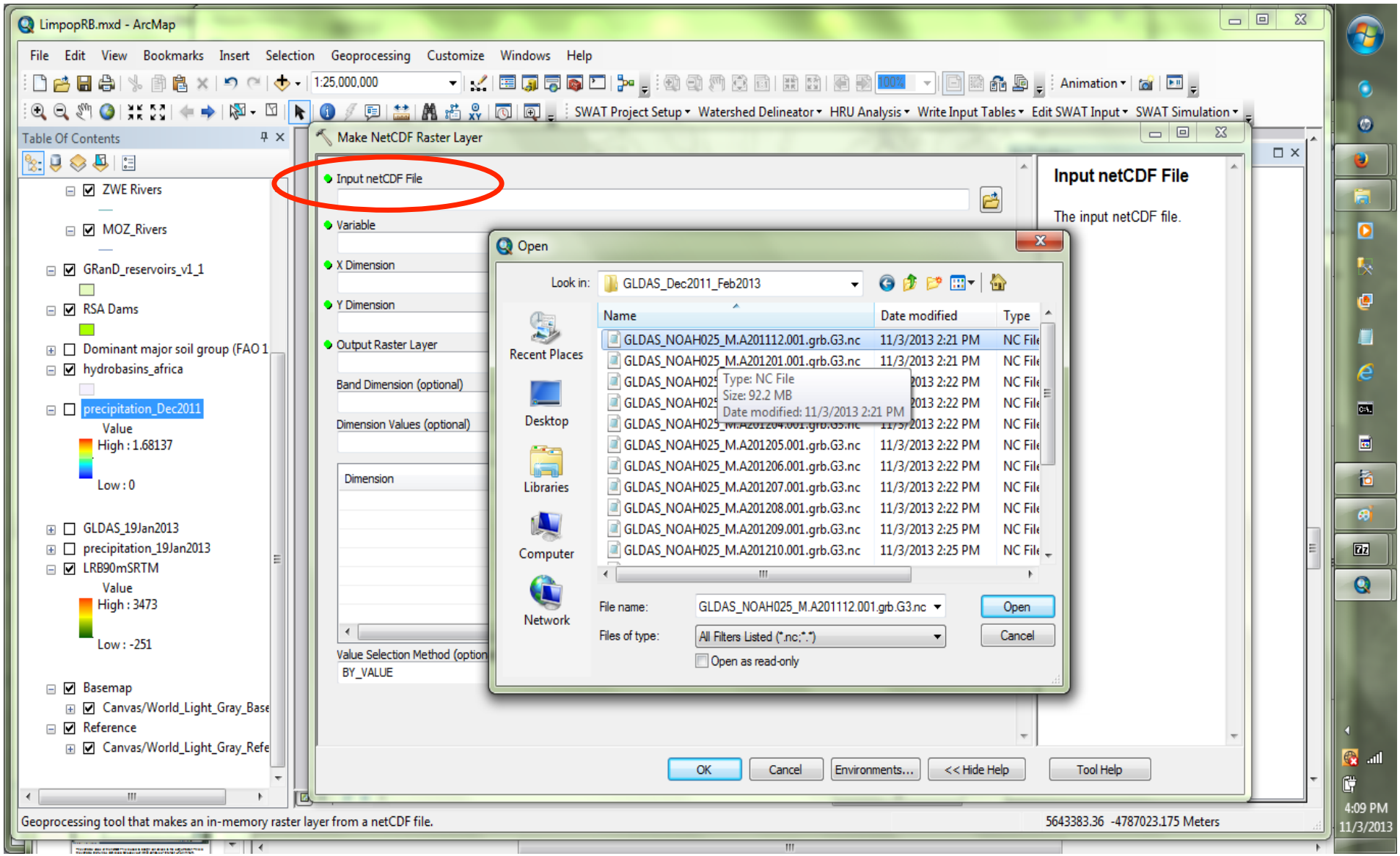
Import GLDAS Data



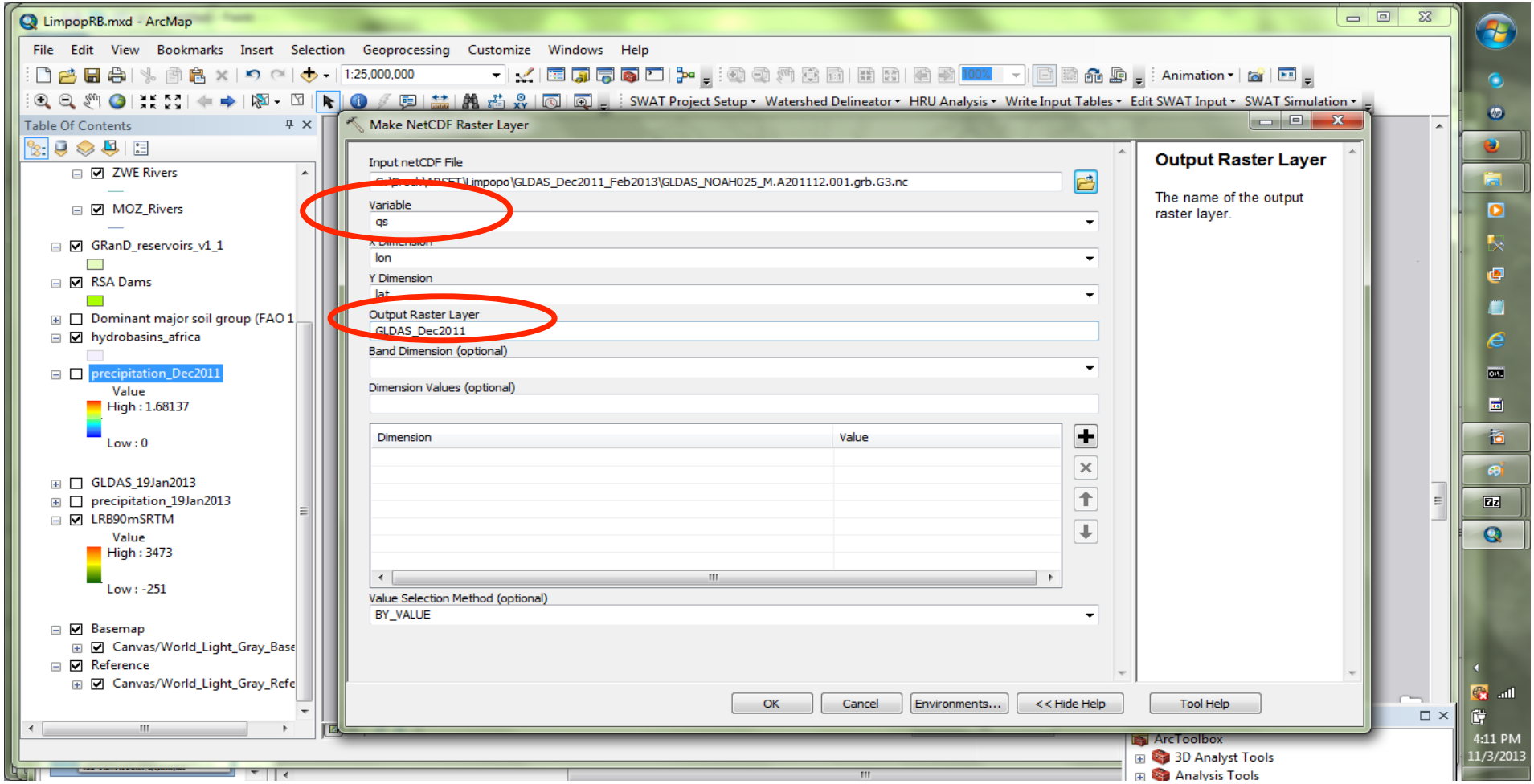
Under the Geoprocessing Tab, Open the ArcToolbox.Open the Multidemensional toolbox, choose the Make NetCDF Raster Layer tool



Make netCDF Raster Layer tool



Select your netCDF file for the Input netCDF File value

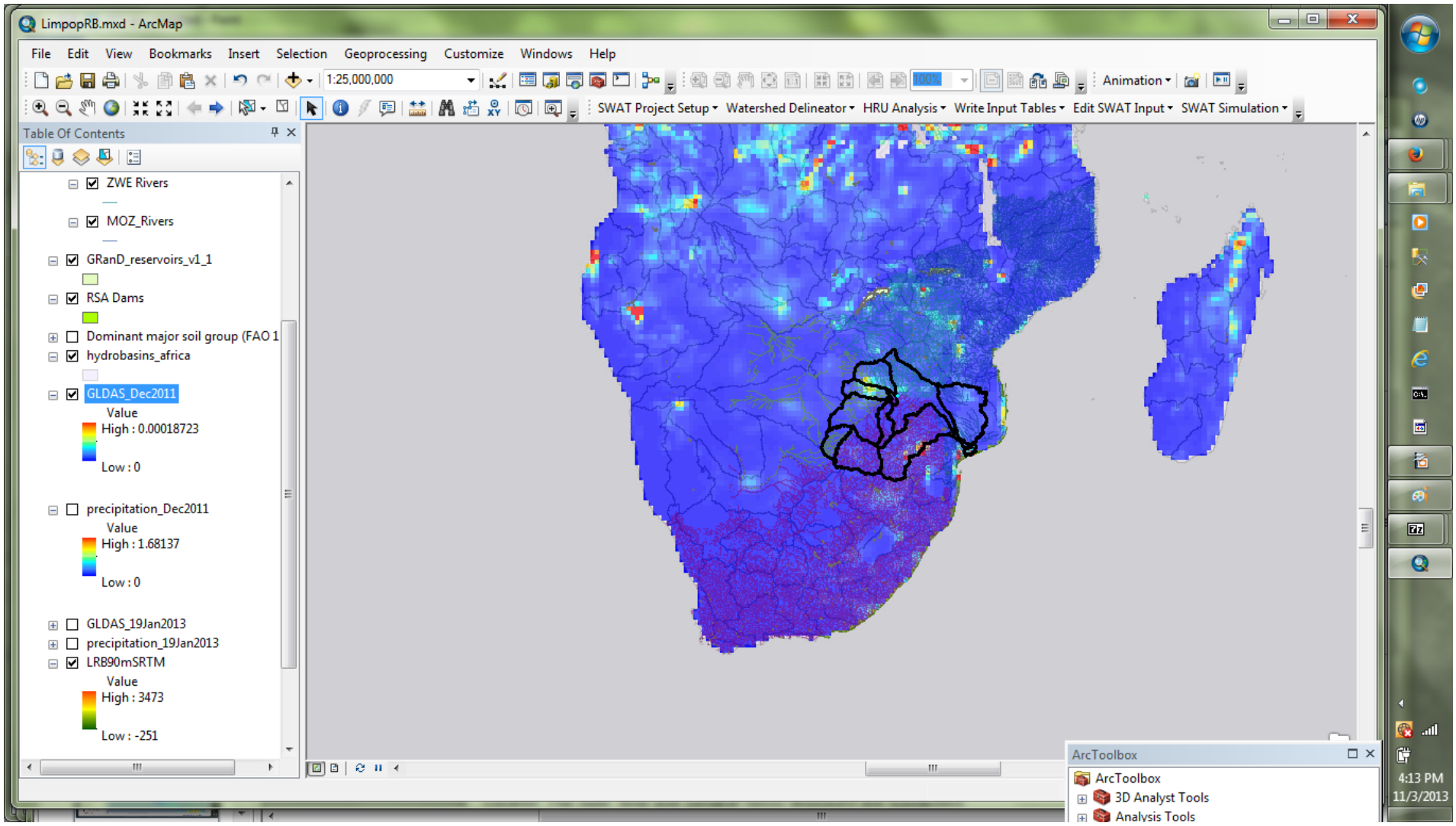


The variable value of the netCDF file is used to assign cell values to the output raster. This is the variable that will be displayed. Choose your initial variable of interest. Upon import, however, all variables are included in the netCDF layer.

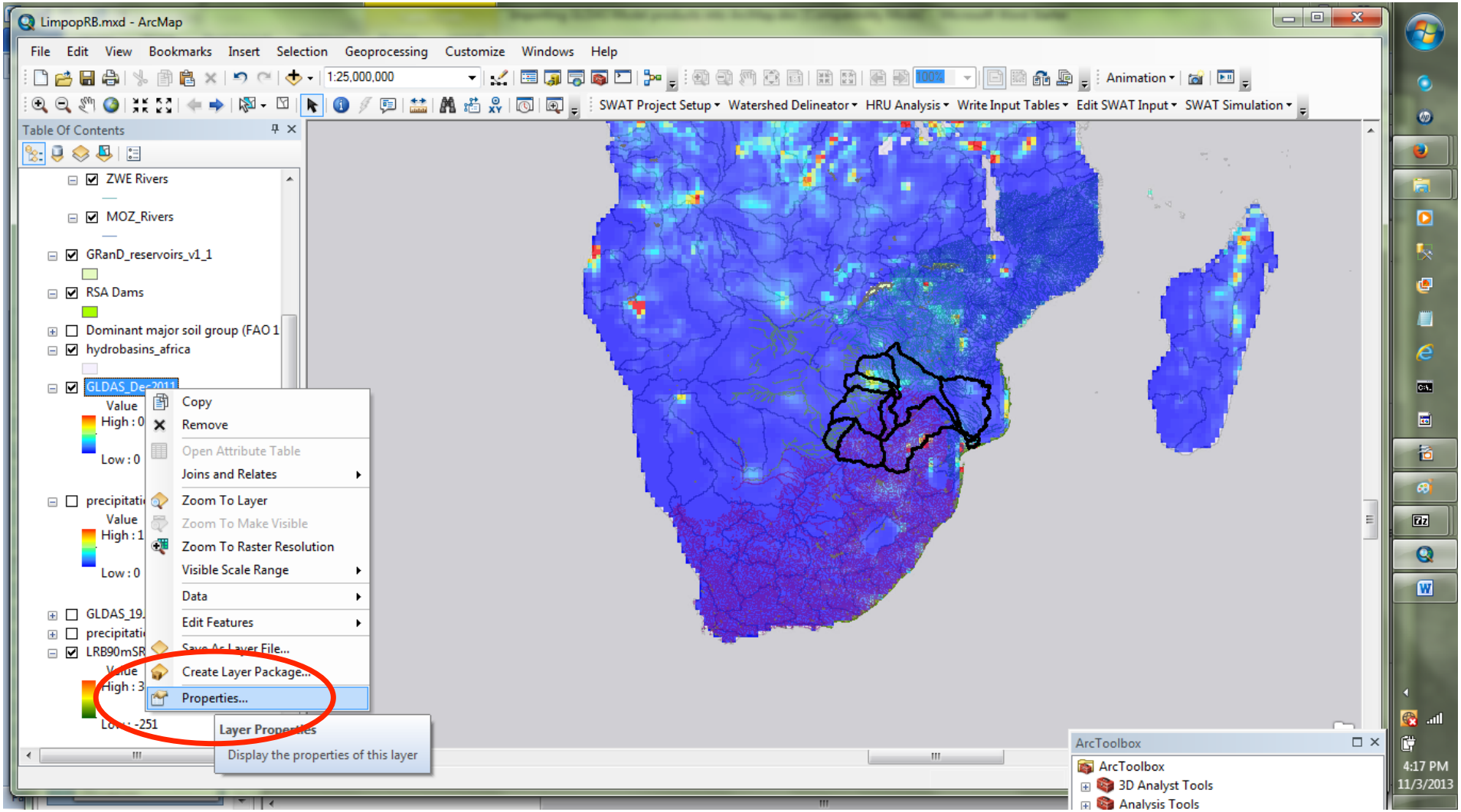
For the X Dimension field, choose longitude (lon).

For the Y Dimension field, choose longitude (lat).

For the Output Raster Layer, type an appropriate name for the resulting raster file to be created. The date, time and variable being displayed are suggested.



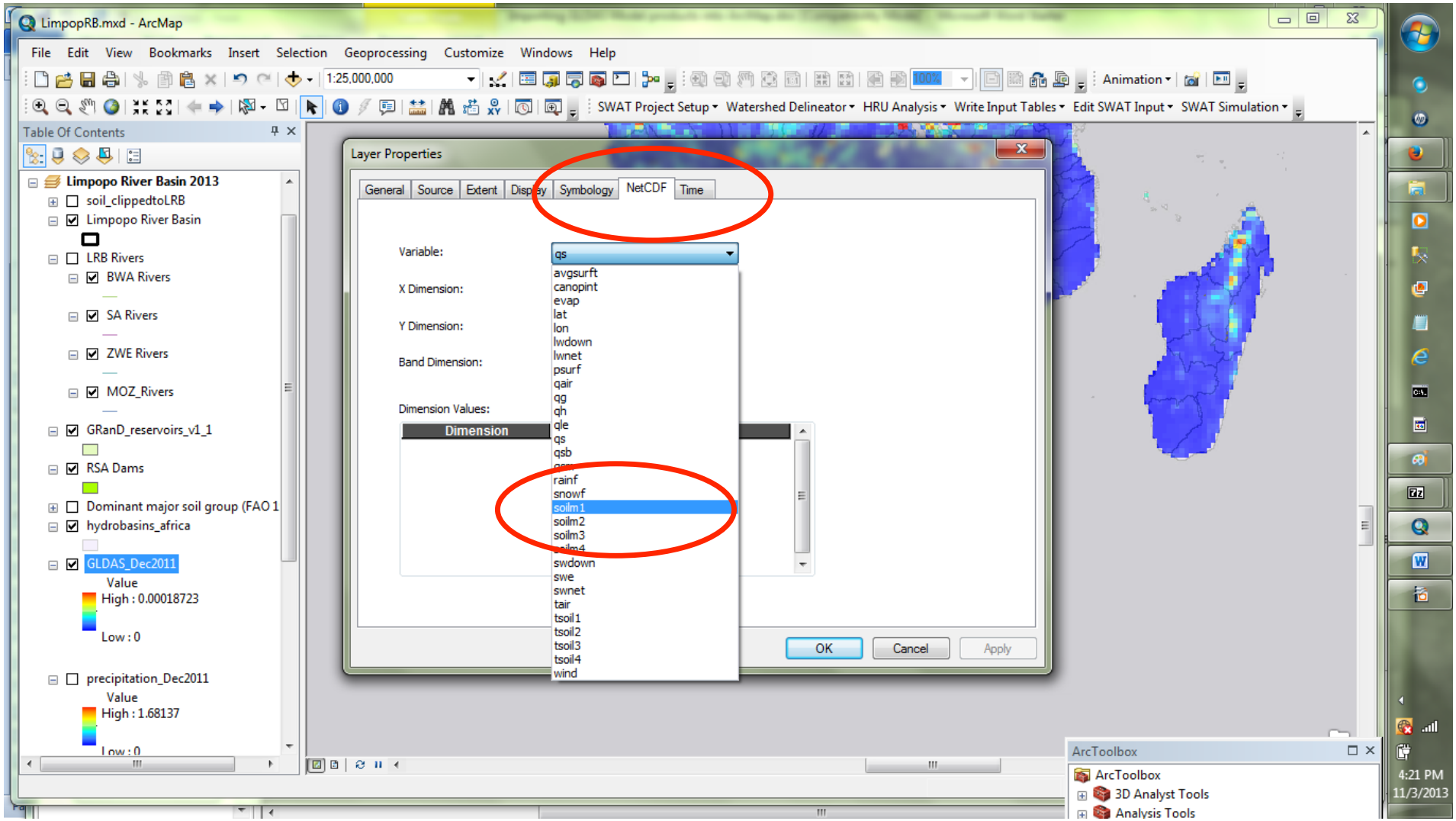
Click ok and the GLDAS product and initail variable chosen in the tool will be displayed as a layer in ArcMap. This is Surface Runoff (**qs)** kg/m^2/s



You may choose which model variable will be displayed.

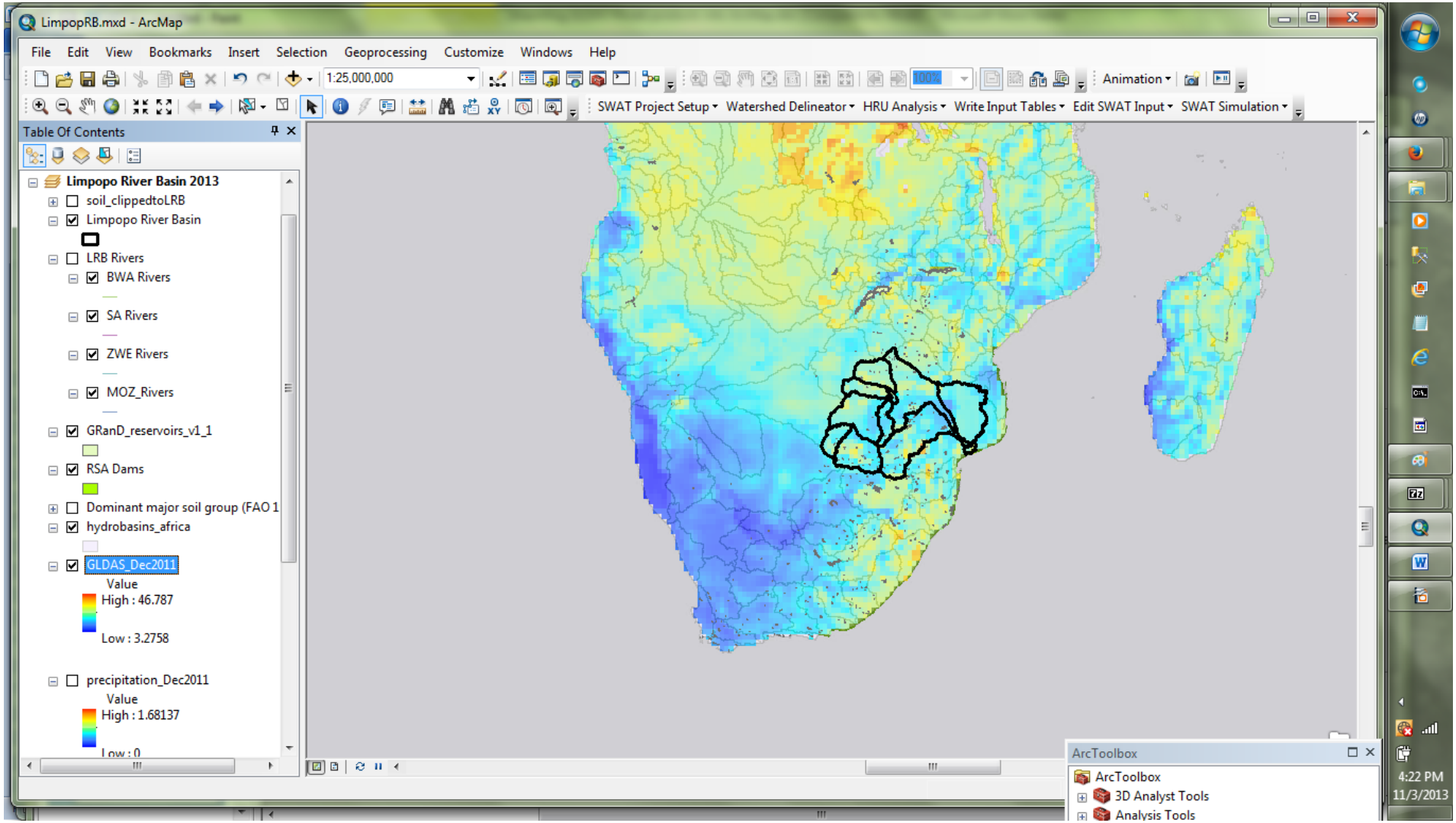
Right click your newly added netCDF layer in the Table of Contents section of ArcMap.

Navigate to the properties and open.



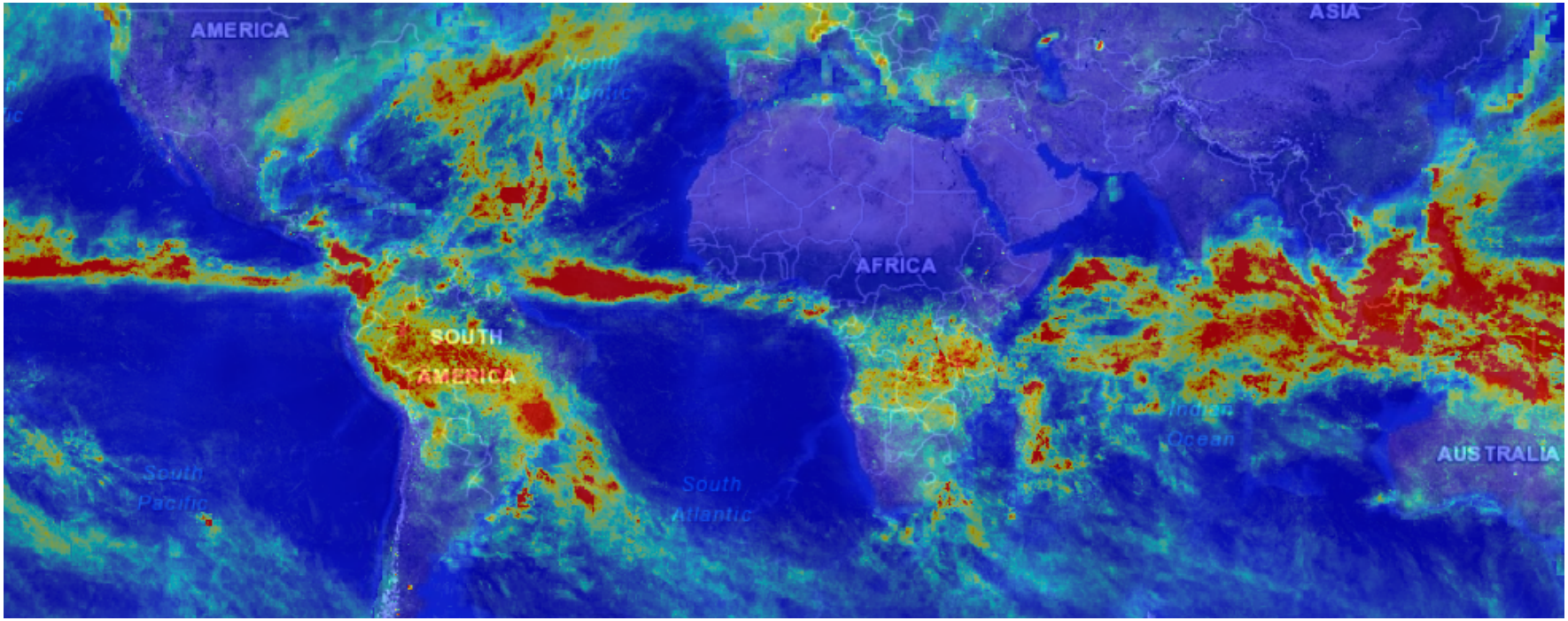
Open the NetCDF tab.

Under the Variable drop down arrow, you may choose which variable to be displayed.



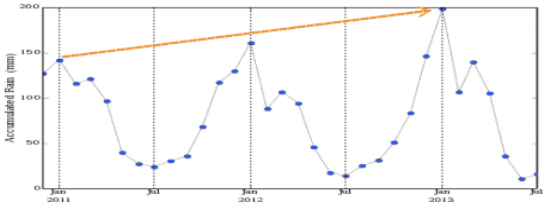
Changed variable soil moisture, 0-10 cm **(soilm1)** kg/m^2

While TRMM and GLDAS data was spatially subsetted for Giovanni visualization, when the netCDF files are downloaded the files contain global data.

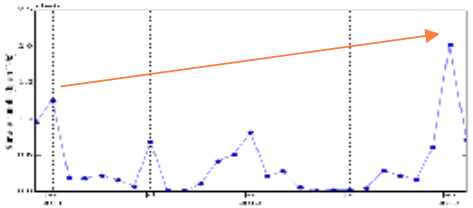


Annual Comparison of TRMM Accumulated Rain and GLDAS Surface Runoff in the Limpopo River Basin

Accumulated Rain (mm)



Surface Runoff (kg/m^2/s)

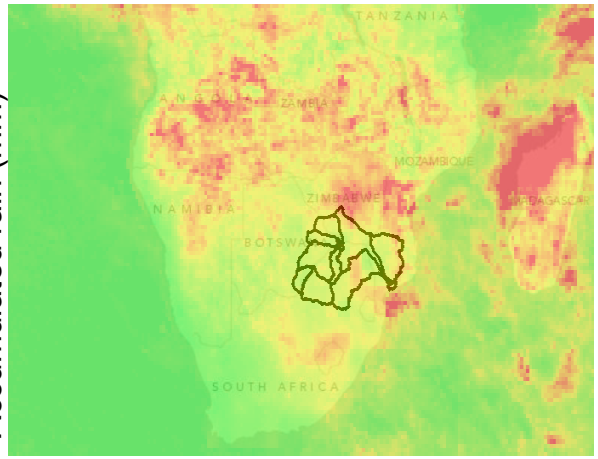


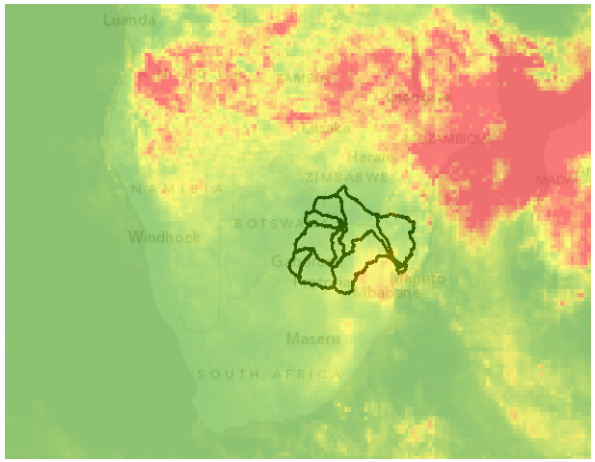
January 2011

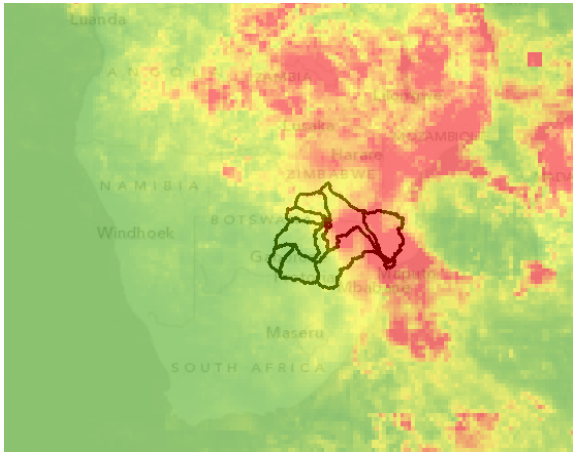
January 2012

January 2013

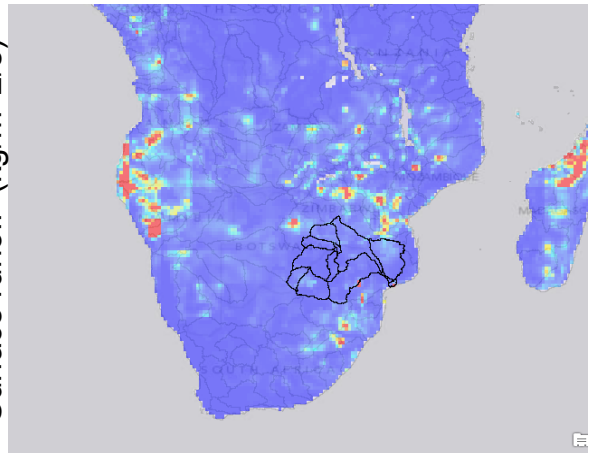
Accumulated rain (mm)

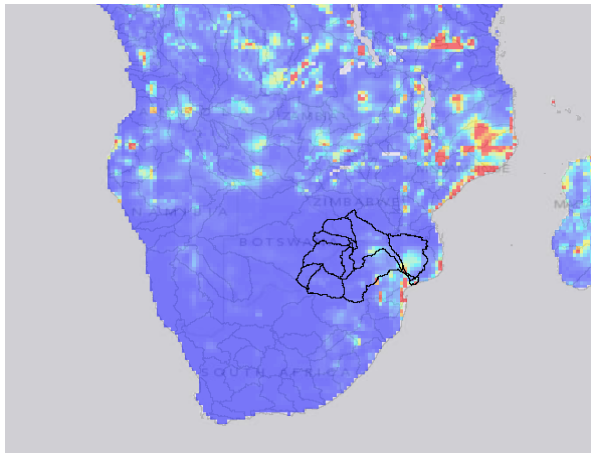


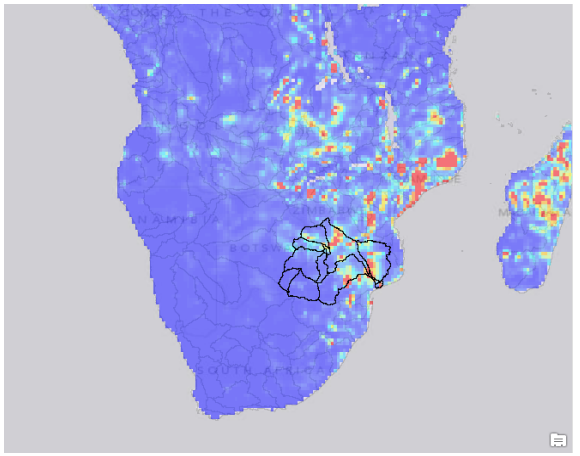




Surface runoff (kg/m^2/s)

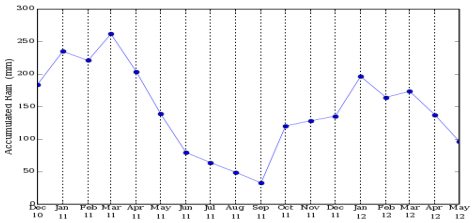




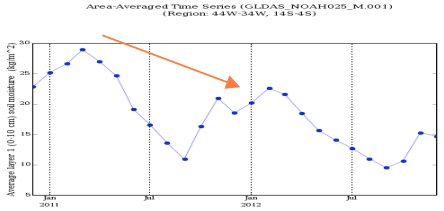


Seasonal and Annual Comparison of TRMM Accumulated Rain and GLDAS Soil Moisture in NE Brazil

Accumulated Rain (mm)



Soil Moisture (kg/m^2)



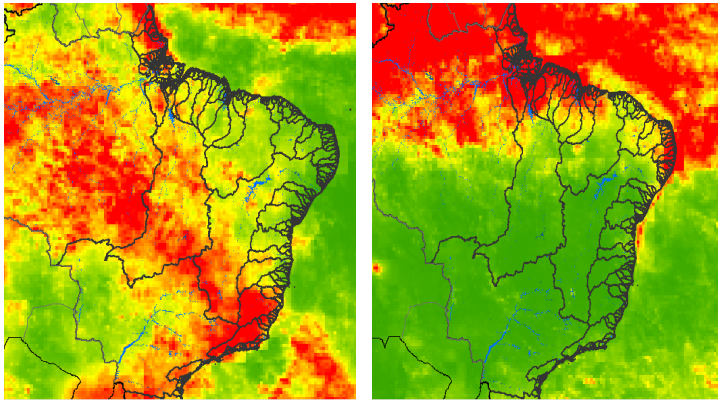
Dec 2010

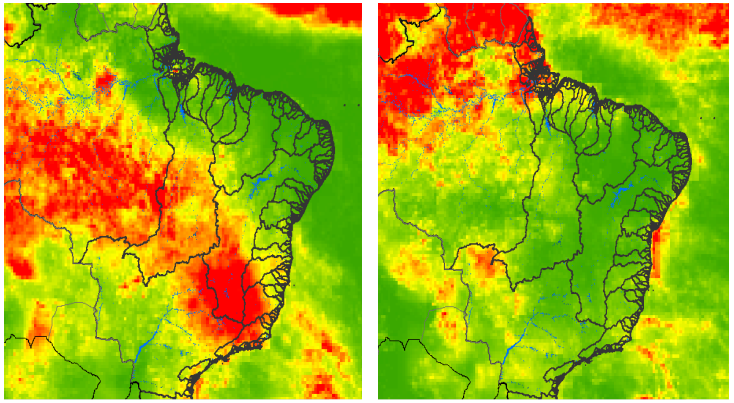
May 2011

Dec 2011

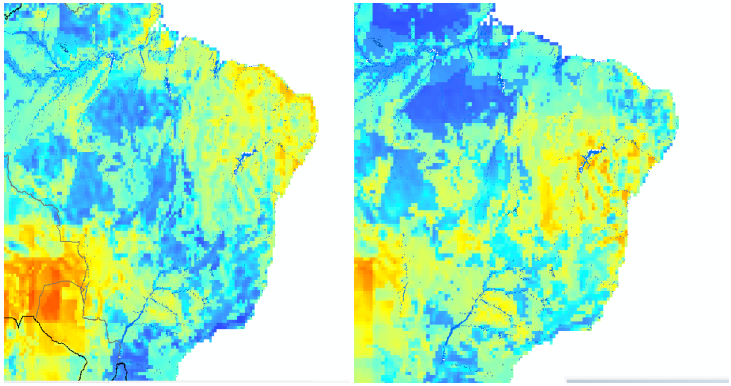
May 2012

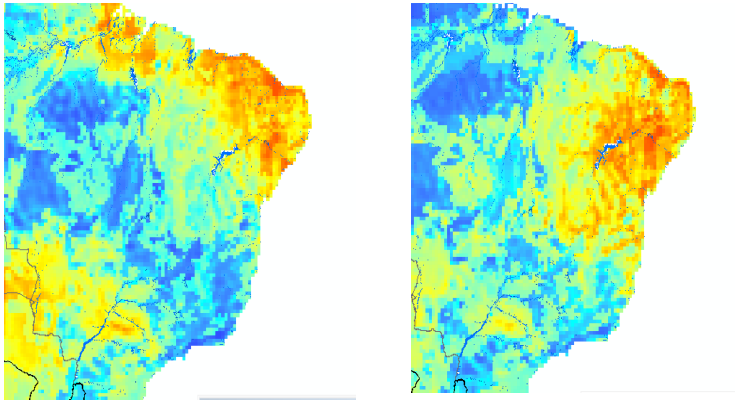
Accumulated rain (mm)





Soil Moisture (kg/m^2)





GLDAS Variable Abbreviations

avgsurft

** average surface temperature k

canopint

** total canopy water storage kg/m^2

evap

** total evapotranspiration kg/m^2/s

lwdown

** surface incident longwave radiation w/m^2

lwnet

** net longwave radiation w/m^2

psurf

** surface pressure pa

qair

** near surface specific humidity kg/kg

qg

** ground heat flux w/m^2

qh

** sensible heat flux w/m^2

qle

** latent heat flux w/m^2

qs

** surface runoff kg/m^2/s

qsb

** subsurface runoff kg/m^2/s

qsm

** snowmelt kg/m^2/s

rainf

** rainfall rate kg/m^2/s

swe

** snow water equivalent kg/m^2

swdown

** surface incident shortwave radiation w/m^2

GLDAS Variable Abbreviations

swnet

** net shortwave radiation w/m^2

snowf

** snowfall rate kg/m^2/s

soilm1

** 0-10 cm average layer 1 soil moisture kg/m^2

soilm2

** 10-40 cm average layer 2 soil moisture kg/m^2

soilm3

** 40-100 cm average layer 3 soil moisture kg/m^2

soilm4

** 100-200 cm average layer 4 soil moisture kg/m^2

tsoil1

** 0-10 cm average layer 1 soil temperature k

tsoil2

** 10-40 cm average layer 2 soil temperature k

tsoil3

** 40-100 cm average layer 3 soil temperature k

tsoil4

** 100-200 cm average layer 4 soil temperature k

tair

** near surface air temperature k

wind

** near surface wind magnitude m/s